SEE AMERICA

Safely- Comfortably- Economically

SOUTHERN PACIFIC
DAYLIGHT LIMITED
HONDA, CALIFORNIA

Reliance HY-CROME *Spring Washers*

Field tests and laboratory research experiments, clearly indicate the development of wear and looseness in bolted assemblies is inevitable and unavoidable.

DOUBLE
HY-CROME

Double Hy-Crome Spring Washers, under compression, maintain a tension over a reactive range from solid, which will adequately compensate for looseness and retard wear.

EATON MANUFACTURING COMPANY

RELIANCE SPRING WASHER DIVISION

MASSILLON, OHIO

Sales Offices: New York, Cleveland, Detroit, Chicago, St. Louis, San Francisco, Montreal

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WHAT'S THE "SHOCK VALUE" AT 70 M.P.H.?

What happens when the pony wheels strike a guard rail? What takes place when a nosing truck is jerked into line for safe passage through a frog?

Even the roughest sort of an approximation will show the terrific shock that the guard rail must take. And even a casual consideration will bring out these characteristics that are essential in guard rails: resilience, toughness, and a means of securing which cannot stretch or fail under impact.

Bethlehem's Hook-flange Guard Rail embodies all three of these characteristics. It is resilient in design and material, yet it cannot overturn nor back away. It is made of rolled steel and has never broken or failed in service. It is not secured by bolts nor braces, but by a combination of the hook-flange, which prevents overturning, and a special shoulder tie plate which prevents spreading.

The Bethlehem Hook-flange Guard Rail is widely used. Some railroads prefer it because of its one-piece construction. Others have called it the most rugged heavy-duty guard rail made. Both agree that it minimizes shock, stands up under impact, and provides positive guarding action.

BETHLEHEM STEEL COMPANY

A SPRING IS ONLY AS GOOD AS ITS

ABILITY TO RE-ACT

Against Wear

AND *Equally Important*

is its ability to Maintain

HIGH REACTION

through Years of Service.

ONLY VERONA FIXED TENSION TRIFLEX SPRING

Meets These Requirements

Don't fail to attend the Roadmasters' and Maintenance of Way Convention, and the Track Supply Association Exhibit —September 10-12—Hotel Stevens Chicago

WOODINGS-VERONA

TOOL WORKS VERONA, PA.

SINCE 1873 SINCE 1873

FAIRMONT LEADS IN FEATURES THAT SERVE YOU BEST

REAR LIFT—145 LBS.

8-13 H.P. ROLLER BEARING ENGINE

HINGED SEAT-TOP

WATER-COOLED

BELT DRIVE

THE Fairmont S2 SERIES "F" PULLS BIG LOADS...

Yet Is Easily Handled By TWO Men!

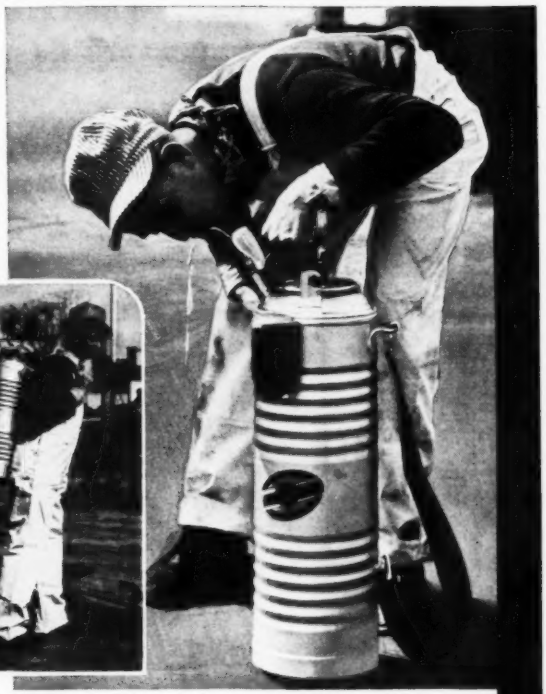
Because of its tremendous reserve of power, light weight, large capacity and sturdy construction, the Fairmont S2 Series "F" car can be used on many types of hauling jobs. Power from its water cooled roller bearing engine is transmitted to the wheels by Fairmont's time-proved endless cord belt drive. The three Hy-Load roller bearings in the crankshaft have 40% greater load capacity than ordinary ball bearings. Easy to maintain as well as longer wearing, these roller bearings contribute much to the greater economy of the Fairmont S2 Series F. Extension lift handles reduce the lift at the rear to 145 pounds and permit use by only two men for inspection service. Before you buy any section cars investigate this modern eight-man unit. Ask for Bulletin 394. It is only one of many styles in the Fairmont line. Fairmont Railway Motors, Inc., Fairmont, Minnesota.

Performance

OF ALL THE CARS IN SERVICE TODAY

INCREASED EFFICIENCY *and* PRODUCTION

ARE MADE POSSIBLE WHEN WORKMEN ARE SUPPLIED WITH COOL CLEAN WATER AND SALT NECESSARY TO MAINTAIN MUSCULAR ENERGY



THE DOBBINS PORTABLE DRINKING FOUNTAIN supplies pure cool drinking water under complete sanitary conditions to crews of workmen and eliminates the necessity of pails, kegs, dippers and individual cups. The Dobbins Portable Drinking Fountain and Salt Dispenser saves the employer pay roll losses by supplying the necessary salt and water thus aiding in the prevention of heat prostration, cramps, etc., keeping the man on the job healthy and efficient. Regardless of where your men are employed, they can now be assured the same protection from disease spreading drinking equipment that is afforded in the bubbler drinking fountain used in modern industrial plants.

Over 100,000 Dobbins Portable Fountains Are Now in Use

$12.50

Salt for MUSCULAR ENERGY

THE DOBBINS SALT DISPENSER contains 500 tablets, is modern in design and smooth in performance. The salt tablet chamber has no metallic parts to cause corrosion or to prevent the dispenser from functioning. Top is transparent and THREADED on. Guide Cup is made of stainless steel. Protect workmen from loss of time due to heat prostration with salt and water—protect yourself against loss through higher workmen's compensation.

Price each **$2.75**

- **SANITARY**
- **ECONOMICAL**
- **DURABLE**
- **FOOL-PROOF**

MEETS THE REQUIREMENTS OF ALL PUBLIC HEALTH AUTHORITIES

Mounting Bracket . . . for inside and outside use. Easy attached to trucks, tractors, and locomotive cabs. Price Each **$4.50**

Spill Cup catches the over-flow when fountain is used indoors. One gallon capacity. Price Each **$3.50**

Carrying Strap Adjustable, Water-proof Carrying Strap. Price Each **$1.00**

MAIL THIS COUPON TODAY!

DOBBINS MFG. CO.
Elkhart, Indiana

GENTLEMEN:

Please send me more information on the Dobbins Portable Drinking Fountains.

Firm Name .....

By .....

Address .....

DOBBINS MANUFACTURING CO.
ELKHART, INDIANA

FOR LOWER COSTS

on Reconditioning Crossings and Frogs

...use these time-proved AIRCO methods

Worn Frogs and battered rail ends are quickly reconditioned with the Airco Oxyacetylene Process — then heat-treated with the same torch for longer life. These operations may be done either in the shop as illustrated, or, on the road if desired. They are but two of the many ways in which the Airco Oxyacetylene Flame is cutting maintenance costs from coast to coast. » » » The practical experience and advice of the members of our Applied Engineering Department is at the service of Airco's railroad customers for problems such as rail end cropping, building up rail ends, hard surfacing, flame cutting locomotive and car parts, or in any other service in which Airco methods can be of assistance to you.

AIR REDUCTION

General Offices: **60 EAST 42nd ST., NEW YORK, N. Y. DISTRICT OFFICES IN PRINCIPAL CITIES**

● SERVING RAILROADS FROM COAST TO COAST ●

Leveling Cropped Rail

These two Nordberg Precision Grinders are equalizing the height of cropped rail relaid on this branch line after having seen from 16 to 20 years of main line service. After grinding, the ends were hardened, greatly prolonging the life of the rail.

This cup wheel grinder with its precision accuracy is ideal for leveling and equalizing the height of cropped rail. Rail so ground gives smoother riding than new rail and by preventing end batter, the useful life of rail is increased. On average cropped rail, two grinders will finish about a mile of track or 350 joints per day.

In addition to grinding cropped rail, Nordberg Precision Grinders are equally efficient for grinding welds, removing mill tolerance, taking off the hump occasioned by wear adjacent to hardened rail ends, grinding out corrugations and wheel burns. This grinder is so designed that the contour of the rail surface is accurately maintained.

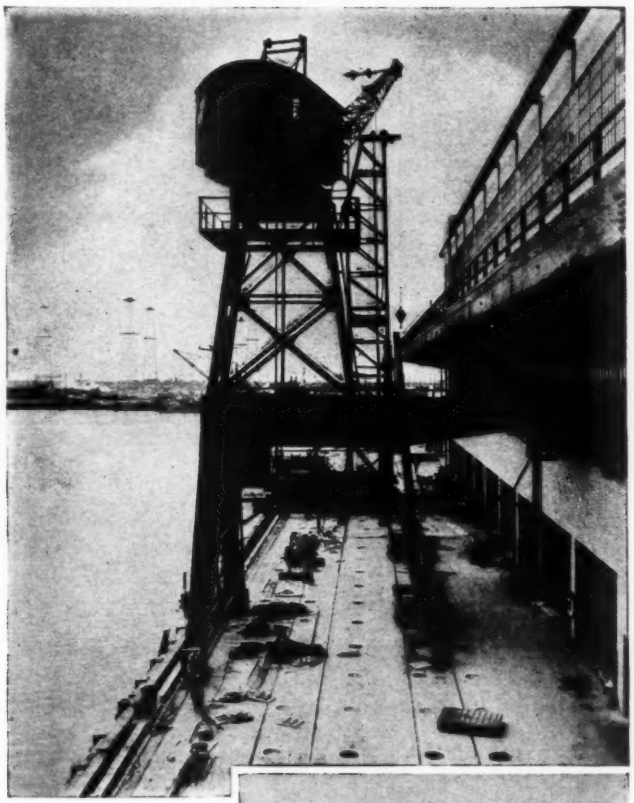
PUT THESE NORDBERG POWER TOOLS TO WORK ON YOUR MAINTENANCE JOBS

Precision Grinder	Surface Grinder	Utility Grinder
Adzing Machine	Spike Puller	Track Wrench
Power Jack	Rail Drill	Track Shifter

NORDBERG MFG. CO. MILWAUKEE WISCONSIN

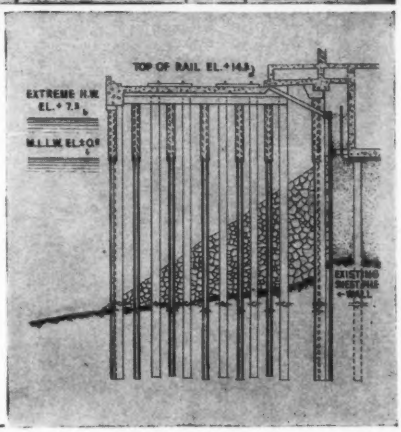
Export Representative—WONHAM Inc.—44 Whitehall St., New York

H-PILES *simplify a Tough Job* OF WHARF UNDERPINNING!



GENERAL VIEW OF OPERATIONS *showing cored holes on dock through which U·S·S Steel Bearing Piles were driven. In the background, note contractors driving equipment mounting Vulcan No. 0 hammer. Gantry crane in foreground, part of permanent plant equipment, was utilized for moving steel to driving rig. Piles averaged 75 ft. in length—this length was obtained by weld-splicing shorter sections in the field.*

Consulting Engineers: White & Squire, San Francisco. General Contractors: Tavares Construction Co., Los Angeles.



Over 40,000 lin. ft. of U·S·S Steel Bearing Piles provide safe, fast and economical foundation . . .

FOUNDATION engineers will find this wharf reconstruction for the Ford Motor Company plant at Long Beach, Calif., worth careful study.

How to reinforce the wharf and foundations for adjacent plant structures, menaced by the serious disintegration of the original material—and how to provide a strong, lasting and shock-resistant foundation without tying up plant and wharf facilities—were problems that called for unusual engineering skill and ingenuity.

The photographs and diagrams shown here illustrate how this job was handled—and completed to predetermined schedules without hitch or hold-up.

The U·S·S Steel Bearing Piles used in this underpinning (CBP-124 and CBP-103, weighing 74 lbs. and 57 lbs. per lineal foot respectively) averaged 75 feet in length, were driven with average penetration of from 40 to 50 feet, give estimated load-bearing value approximately 50 tons per pile. Many of these piles were driven through 25 feet of rock rip rap, without the use of driving points, and with no unusual difficulties.

Highly important was the relatively small size of these steel H-pile sections. Their small displacement permitted driving without any disturbance in the existing structure and made unnecessary the expense and trouble of removing the existing piles. On the wharf proper, holes were cored through the 3-foot thick concrete floor and through these the H-piles were driven. In all, 556 H-piles were driven on this project—total supported area 50,650 sq. ft. approx.

. . .

We are proud to add this interesting job to the long list of successful foundation structures in which U·S·S Steel Bearing Piles have proved their efficiency and economy. More than 4 million feet of these versatile wide-flange CBP Sections, especially designed for heavy pile use, have been driven in the past 4 years. We believe it will pay you to investigate them for your projects—especially when conditions are unusual.

USS

STEEL BEARING PILES

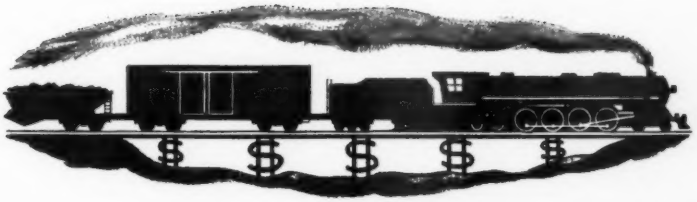
CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh and Chicago

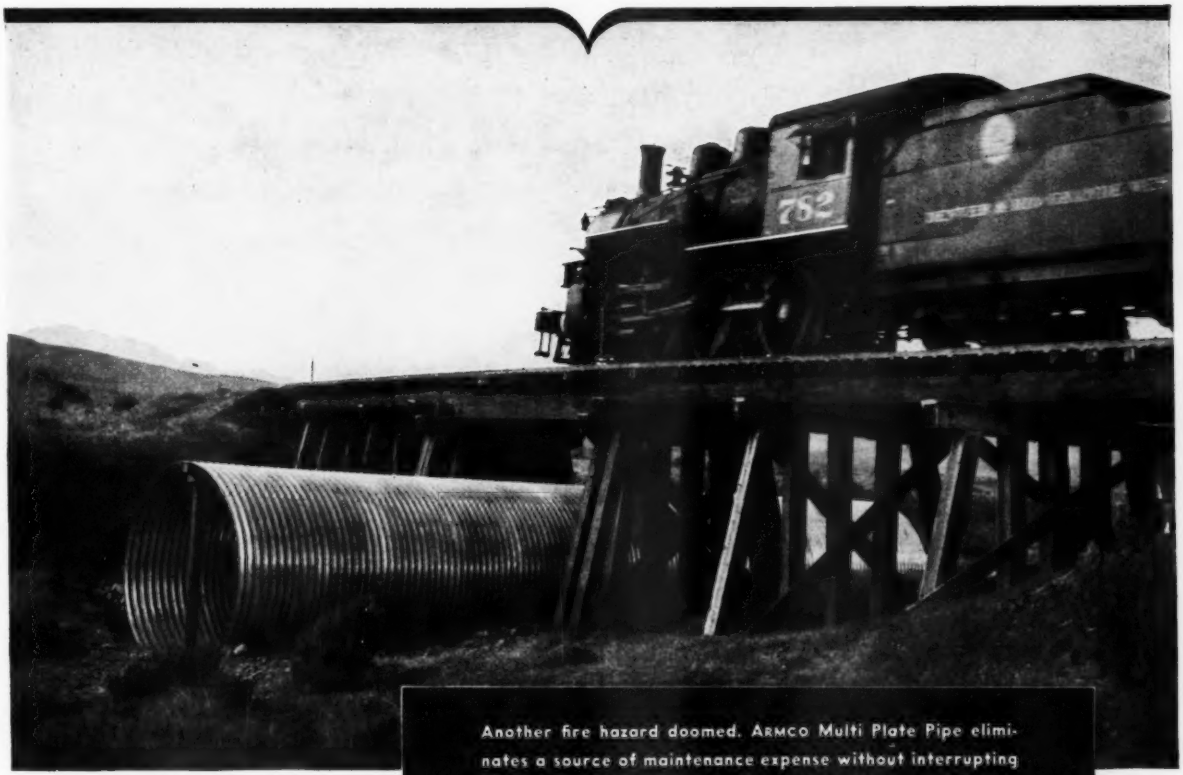
Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

UNITED STATES STEEL

MILES of SMILES
Traveling on one of those super-smart streamliners means enjoyable, comfortable, restful Miles of Smiles, because the train is equipped with roller bearings. The majority of these famous trains are equipped with Timken Bearings. ¶ When Timkens are used on locomotives, passenger and freight cars, hot-boxes become a nightmare of the past—vibrationless high speeds are possible—costs are greatly reduced—schedules are faster, more dependable. ¶ In short, everyone benefits and that means Miles of Smiles for all! Always travel on a Timken equipped train and you travel de-luxe! The Timken Roller Bearing Company, Canton, Ohio.
TIMKEN
Trade-mark Reg. U. S. Pat. Off.
TAPERED ROLLER BEARINGS
TIMKEN BEARING EQUIPPED
NOTICE
Look for the trade-mark TIMKEN on every bearing, whether buying new equipment, or replacing a Timken Bearing in your automobile or truck, industrial or farm machinery. That trade-mark is your assurance of quality.
This advertisement appears in The Saturday Evening Post April 20 and Newsweek May 13.



WHY PROP 'EM UP WITH DOLLARS?



Another fire hazard doomed. ARMCO Multi Plate Pipe eliminates a source of maintenance expense without interrupting traffic. Struts are removed after initial settlement of the fill.

• Are you another railroad man who's tired of pouring money into old timber structures? The simple, effective thing to do is replace them with ARMCO Multi Plate Pipe or Arches. It is the safe, practical answer to recurring maintenance cost.

Your regular crew can assemble Multi Plate structures quickly and economically in any kind of weather. The heavy-gage corrugated iron plates are easily bolted together and no power equipment is needed. Schedules are not disrupted.

You'll find too that ARMCO Multi Plate has ample structural strength to meet standard railroad loading specifications with a wide margin of safety. There are no joints and its uniform strength is adaptable to unstable ground conditions. Moreover, you can depend on Multi Plate to serve for years without attention because it is made from galvanized ARMCO Ingot Iron in thicknesses up to $\frac{5}{32}$-inch.

Besides saving you money ARMCO Multi Plate Pipe or Arches help your roadbeds meet high speed traffic conditions. For data applied to your requirements, just call our nearest office or write us direct. Armco Railroad Sales Co., Incorporated, 771 Curtis Street, Middletown, O. Offices in principal cities.

ARMCO MULTI PLATE

A TYPE OF PRODUCT ORIGINATED AND DEVELOPED BY ARMCO ENGINEERS

TO RAILWAY SUPPLY MANUFACTURERS

"It Helps"

"Bill, we've got a fine backlog of orders on our books now, thanks to your splendid work."

"I'm glad to hear you say that, Boss, but don't give me all the credit."

"Why not?"

"Because you're entitled to some of it yourself."

"That's fine of you to say so, Bill, but what do you have in mind?"

"It's that advertising in *Railway Engineering and Maintenance* that you authorized. It's a great help."

"In what way?"

"In a lot of ways. In the first place, when I go in to see these railway officers they act like they know me—for they're acquainted with our materials. They're half sold when I go in, for that copy you're running certainly rings the bell."

"I'm mighty glad to hear that."

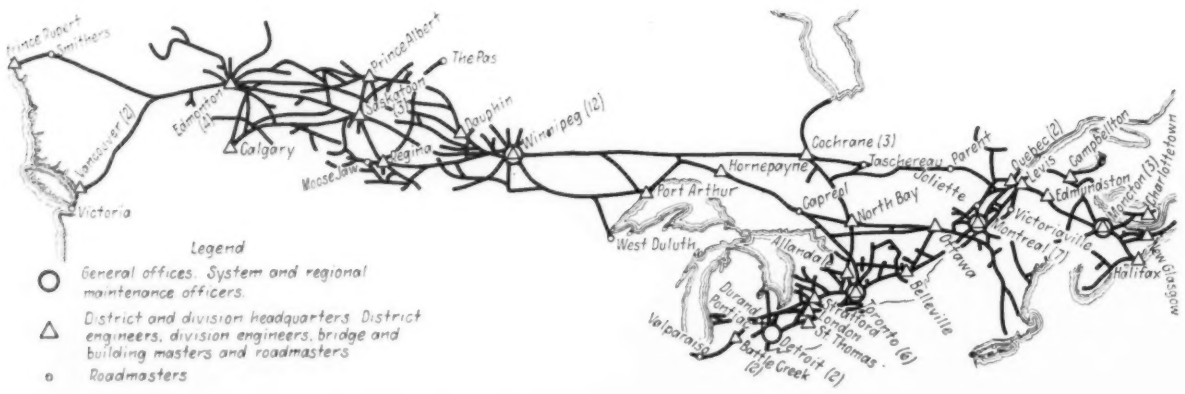
"And Boss, the men out on the line whom I never see are reading our ads too and asking their chief for our materials—and that helps a lot."

"You feel that our advertising is worth while, then?"

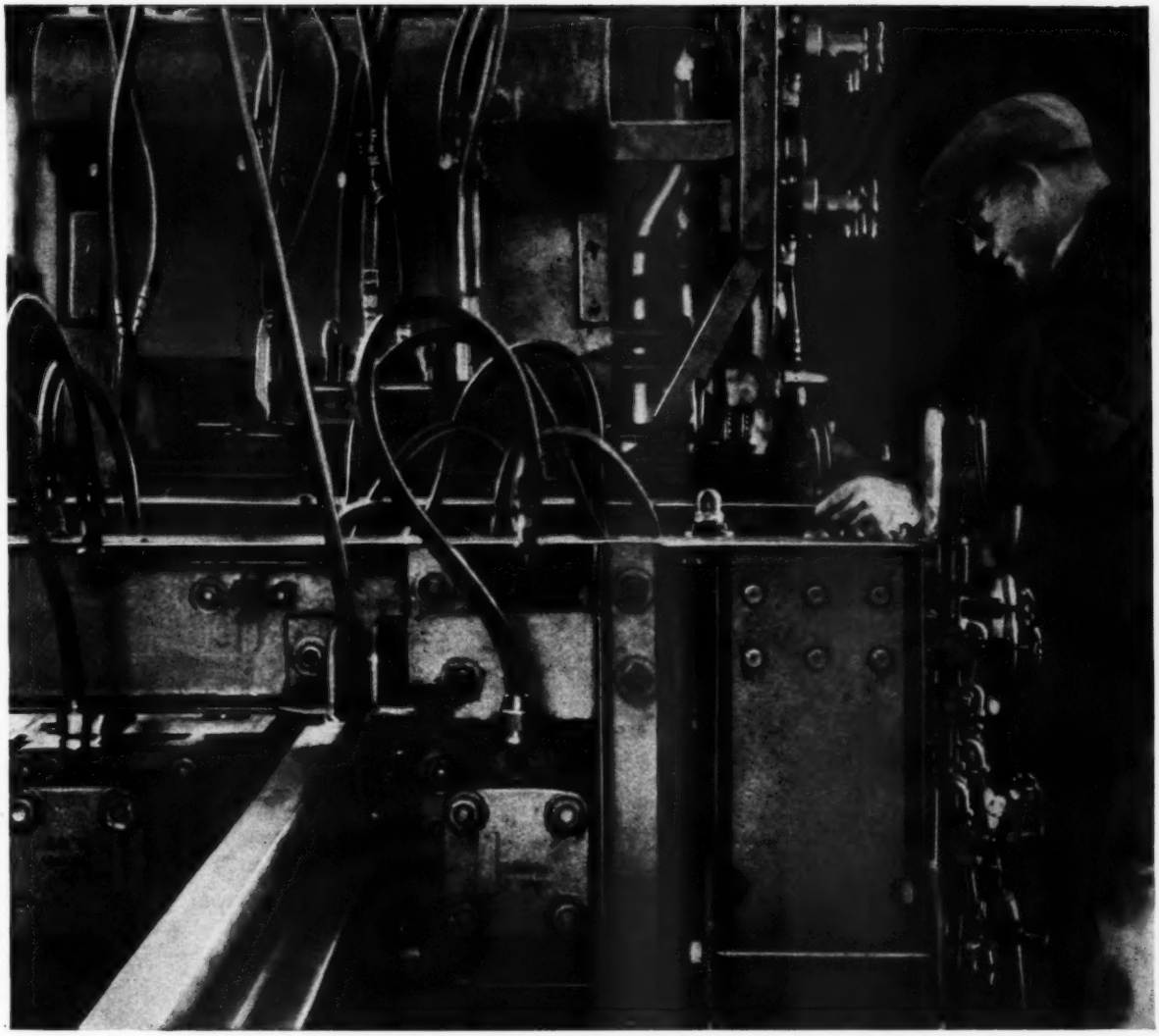
"Feel—I know it is."

"If that's the case, we'll continue it."

Railway Engineering and Maintenance Goes Every Month to 79 Maintenance Supervisory Officers of the Canadian National at **5 General and Regional Offices, 30 Division Offices and 10 Other Supervisory Headquarters,** Scattered All the Way from Charlottetown, P.E.I. and Halifax, N.S., to Prince Rupert, B.C., and Vancouver.
This Magazine Goes Also to 33 Other Subordinate Officers Who Are in Training for Promotion to Supervisory Positions on This Railway.



RAILWAY ENGINEERING AND MAINTENANCE IS READ BY MAINTENANCE OFFICERS OF ALL RANKS



Butt-Welding Rail by the OXWELD METHOD

• Butt-welded rail used in road crossings and station platforms avoids tearing up the pavement to repair rail joints. When installed on open deck bridges, it greatly reduces impact. Butt-welded rail substantially cuts maintenance costs in tunnels and all other installations. Oxweld has been privileged to further its service to American railroads by making available the Oxweld pressure butt-welding method, and other money-saving Oxweld procedures.

THE OXWELD RAILROAD SERVICE COMPANY
Unit of Union Carbide and Carbon Corporation
UCC
Carbide and Carbon Building Chicago and New York

OXWELD RAILROAD SERVICE

SINCE 1912—THE COMPLETE OXY-ACETYLENE SERVICE FOR AMERICAN RAILROADS

The word "Oxweld" is a registered trade-mark of a Unit of Union Carbide and Carbon Corporation.

No. 137 of a series

Railway Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 WEST ADAMS ST.
CHICAGO, ILL.

May 1, 1940

Subject: Calvin A. Lichty

Dear Reader:

News of the death of C. A. Lichty on April 18, as noted on a following page of this issue, will come as a shock to many of you, for few men possessed a wider acquaintance and were claimed as a friend by more of you than "Cal," as he was known to so many of us.

Most of you knew him first and longest as secretary of the American Railway Bridge and Building Association for nearly 32 years. (This organization has had only two secretaries in the more than 46 years of its activities, S. F. "Deacon" Patterson having preceded Mr. Lichty.) To these men, and especially to Cal Lichty, is largely due the credit for the progress that this organization has made during its nearly half-century's service to the railways. Five years ago, Mr. Lichty also took over the secretaryship of the Roadmasters and Maintenance of Way Association, and he has since devoted his entire time to the work of these two organizations.

Cal Lichty's death calls attention to the remarkably constructive service that so many men have rendered and are rendering the railways through their participation in the work of the three associations that have long functioned so efficiently in the engineering and maintenance field. Through service on committees and as officers, many of you have contributed greatly to the promotion of improved practices, a type of service that has done much to stimulate increased efficiency in procedure. For most of you such work has been plus work, taken on voluntarily in addition to your regular duties.

While you have increased the scope of your own knowledge and your value to your own railway by this action, your railway and the railways in general have been the principal beneficiaries of this work. It was in recognition of this fact that the Federal Railroad Administration encouraged the three associations in our field to continue their activities during the war years of a quarter century ago when many other associations were closed down. It was likewise in recognition of the value of their work that the American Railway Engineering Association was encouraged to continue its work throughout the recent depression, while the Roadmasters and the Bridge and Building Associations were among the first to be encouraged to resume activities.

The records of these associations should be a source of pride to all their members. These records have been made possible by men like "Cal" Lichty who have given so loyally of their time and energies to the promotion of the best practices in railroading through co-operative study.

Yours sincerely,

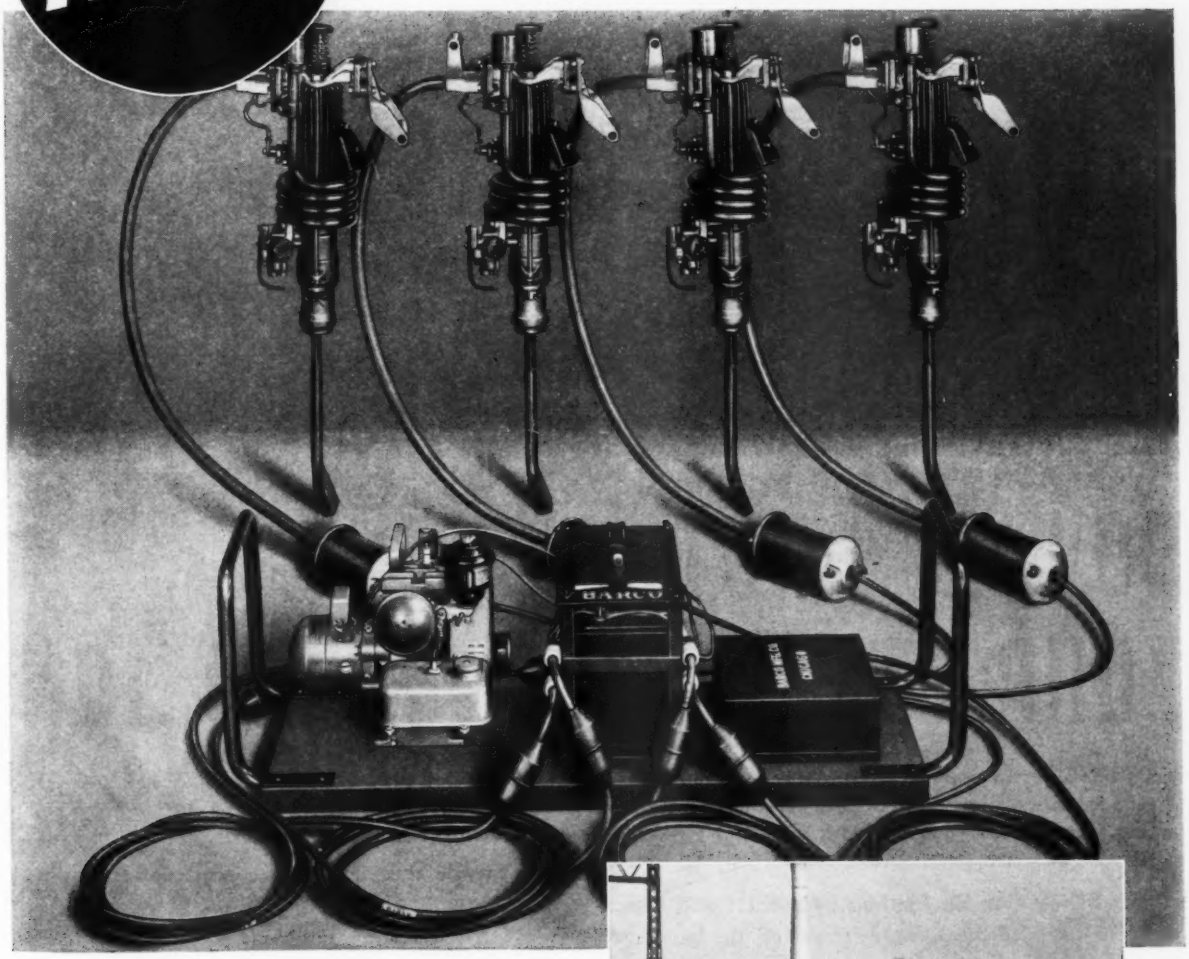
Elmer T. Howson

ETH:KR

Editor

MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.

NOW BARCO TYTAMPERS may also be operated from a CENTRAL POWER PLANT



In Units of 4-8-12-16-20

BARCO self contained unit tytampers with individual batteries have been so successful and universally adopted that we have now made available a very small, inexpensive, light-weight charger and wet battery for continuous group operation. The weight is only 46 lbs. plus the weight of the six-volt battery, which provides low first cost—low cost of operation and low maintenance cost, while still maintaining BARCO simplicity and extreme portability.

Showing power plant on skid operating 12 BARCO tytampers

BARCO MANUFACTURING COMPANY

1805 W. Winnemac Ave. Chicago, Illinois

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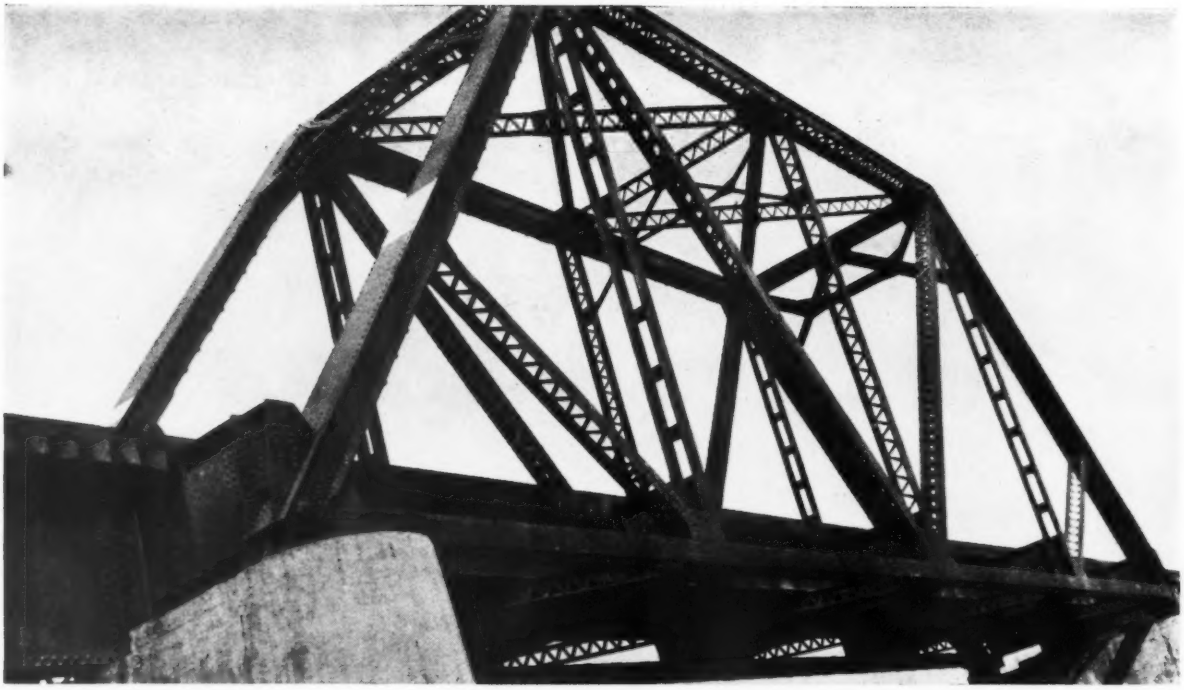
THE HOLDEN COMPANY, LTD.

Montreal — Moncton — Toronto — Winnipeg — Vancouver



BRIDGE STRUCTURES—NO-OX-ID stops the loss of metal and saves half the cost of maintenance by making expensive cleaning unnecessary.

HOW TO PROTECT YOUR STEEL FROM CORROSION

Here's a way to stop loss of metal on all steel structures at a fraction of the cost of ordinary cleaning and painting. Simply coat your steelwork with NO-OX-ID—the original rust preventive.

NO-OX-ID Can Be Applied over Rust and Paint

For corroded areas, merely scrape off the loose rust patches and apply NO-OX-ID "A" Special. NO-OX-ID will penetrate to the metal, stop further corrosion, and loosen the remaining rust scale.

As the old scale falls off, full protection is obtained by touching up the bare spots with NO-OX-ID.

NO-OX-ID Gives Two-Way Protection

NO-OX-ID acts mechanically to keep out moisture and oxygen from the surface and chemically to inhibit corrosion under the film. Write for data book.

TANKS—NO-OX-ID preserves the steel in tanks without contaminating the water.

TURNTABLES—NO-OX-ID keeps turntables, track scales, and other steel structures free of rust at lowest cost. It gives lasting protection.

DEARBORN CHEMICAL COMPANY
Dept. U, 310 S. Michigan Ave., Chicago, Ill.
New York • Los Angeles • Toronto

NO·OX·ID
IRON + OX = RUST
TRADE MARK
The Original Rust Preventive

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MAY, 1940

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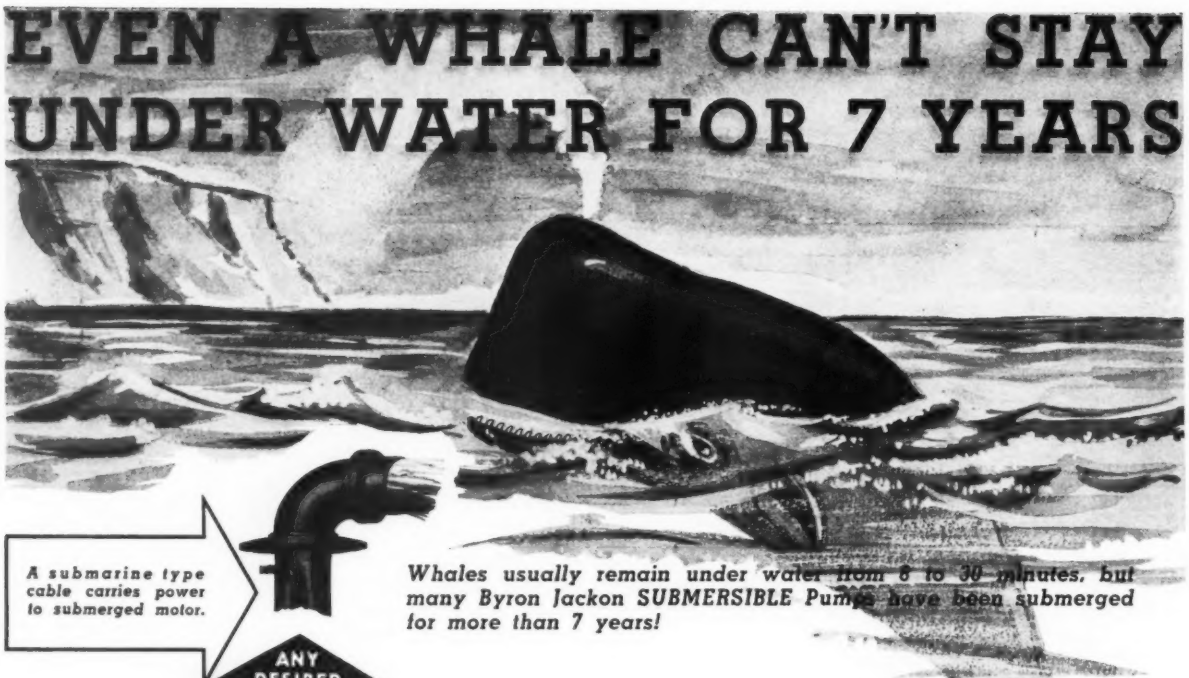
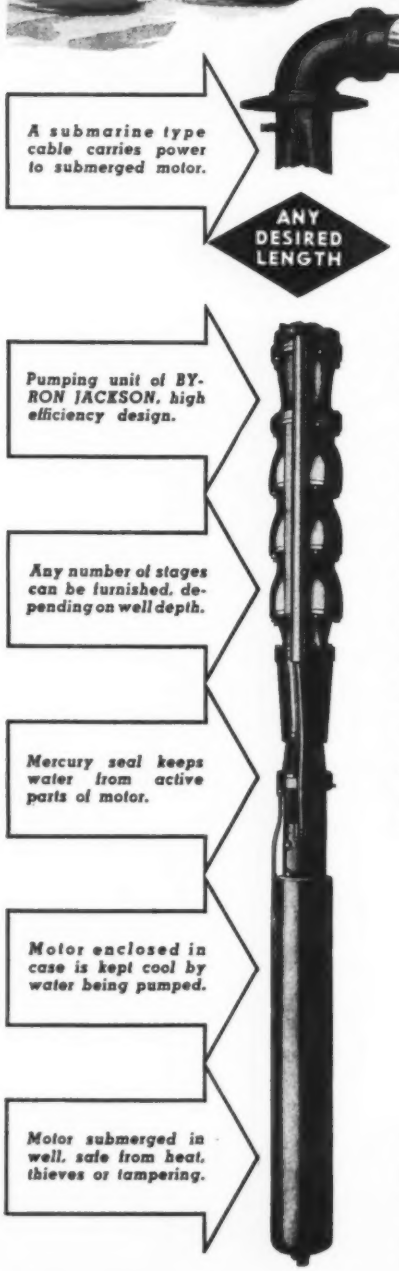
EVEN A WHALE CAN'T STAY UNDER WATER FOR 7 YEARS



Whales usually remain under water from 6 to 30 minutes, but many Byron Jackon SUBMERSIBLE Pumps have been submerged for more than 7 years!


A submarine type cable carries power to submerged motor.
ANY DESIRED LENGTH
Pumping unit of BYRON JACKSON, high efficiency design.
Any number of stages can be furnished, depending on well depth.
Mercury seal keeps water from active parts of motor.
Motor enclosed in case is kept cool by water being pumped.
Motor submerged in well, safe from heat, thieves or tampering.

This successful pump is practically "made to order" for railroad water supply service, and merits your detailed investigation. The SUBMERSIBLE is a successful departure from the conventional deepwell turbine pump with its long shaft and many bearings, which cause unnecessary trouble and expense,—particularly in crooked wells.

The SUBMERSIBLE consists of a special squirrel-cage electric motor, mounted below and direct-connected to an efficient pump assembly. The entire unit—motor and pump—is mounted on the discharge pipe, lowered into the well, and operates at all times completely submerged in the water being pumped. A submarine type cable conducts power to the motor. No pump house is required, only a weather-proof, tamper-proof metal switchbox which can be mounted on a pole safe from floods or vandalism. It is ideal for remote control and for automatic operation. No attendant is required because no inspection, no oiling, no adjustments are needed—the motor is kept at proper operating temperature by the water being pumped, and is unaffected by desert heat or Arctic cold.

Every railway man concerned with water supply is invited to send for the descriptive folder which contains a 44" long cross section illustration of the SUBMERSIBLE, printed in 4 colors. It is free for the asking, and you will not be obligated in any manner—write for it now!

BYRON JACKSON CO.
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BYRON JACKSON

SUBMERSIBLE

Railway Engineering and Maintenance

The Waterways

Is Government Agency Making Money?

THE United States, and especially that part adjacent to the Mississippi and the Missouri rivers, has long been subjected to a most active lobby working for the expenditure of vast sums of money to make navigable the larger streams of the Middle West, especially the Mississippi and the Missouri rivers. In their representations, the advocates of these channels have made broad claims for the economy of transportation on them—all to the detriment of the railways.

An Independent Study

To determine the accuracy of such claims, the United States Government created the Inland Waterways Corporation in 1924, as an agency to engage in barge line operation on the Mississippi and for fourteen years it has engaged in competition with the railways. In this period, its financial results have been the cause of much controversy, arising primarily from the attitude of those in charge of this experiment and their friends of the waterway bloc in publicizing the figures. From the standpoint of the railways, this attitude has been particularly serious because the public is inclined to place more confidence in the integrity of figures originating in government channels than from other sources.

Indicative of the provocative statements issued by this federal agency is one contained in its 1938 report that the Inland Waterways Corporation "earned a cumulative net profit in excess of $2,600,000 in the fourteen years of its existence." Being suspicious of the accuracy of this statement, the Transportation Committee of the United States Chamber of Commerce has studied the operations of the federal barge line and analyzed its results, as a result of which it has reached the conclusion that these operations have fallen short of a reasonable financial success to the extent of some $14,000,000. In other words, it finds that this operations has sustained an average loss of a million dollars a year during the fourteen years of its operation. In arriving at this conclusion, the Committee applied a measuring stick comparable with that which would determine the financial success or failure of a private business or corporation.

The Committee reports, for illustration, that the Corporation's depreciation allowances are quite inadequate, averaging less than 2.5 per cent, while two comparable private barge line companies charge more than 4.5 and 6 per cent respectively. Assuming the conservative figure of 4 per cent, it finds that the depreciation charges since 1924 have been understated at least $4,000,000.

Small Taxes

The Committee of the Chamber of Commerce calls attention also to the discrepancy in taxes paid, including state and local, social security, etc., and states that a privately owned barge line would have paid $1,100,000 more taxes than the Waterways Corporation actually did, even without taking into account federal income and capital stock taxes.

Similarly, the federal agency has escaped other expenses which a private agency would have incurred, including postage and, until recently, the rent of executive offices in Washington. The Committee also states that the Barge Line has enjoyed the government's rates on telegrams. These items are estimated to aggregate $500,000 during these years.

Other items of expense that have not been charged to the Waterways Corporation include the salary of its president, until recently paid by the War Department, and personal injury claims, paid by the United States Employees Compensation Commission, which expenses totaled some $360,000 to the end of 1938.

No Interest

Thus, even after making allowance for some $750,000 of expenses that may be inherent in government operation, as contrasted with private management, the claimed cumulative profit of $2,600,000 is converted into an actual deficit of $2,500,000. But, even this is not the full story, for no consideration has yet been given to the return on the investment of some $25,000,000 of public money in this project. For a private company, this investment would be represented by capital stock and bonds and, because of the hazard of the project, would command a return higher than the ordinary interest rate. The Committee assumed, however, a rate of 4 per cent, which, applied to the investment in the Corporation, would show a charge to the end of 1938 approximating $11,500,000. Adding this amount to the $2,500,000 cited above brings the total deficit to $14,000,000 as compared with the claimed profit of $2,600,000.

Such are the results of the government's venture in waterway transportation as developed by a disinterested agency—results that warrant wide dissemination to counteract the highly misleading figures put out through government channels.

Work Equipment

Considerations Governing its Selection

ON most roads it is no longer necessary for maintenance engineers to offer proof to their managements that work equipment, in competition with hand labor, will reduce the cost of practically every kind of maintenance work, or that the operation of power machines will demonstrate attractive savings. Yet the magnitude of these savings is not the same for all equipment, but varies with the type of machine, the kind of work and the conditions under which it is done, and these variations may range between rather wide limits.

Thus, experience has shown that with good judgment in the assignment of the machines, some types of equipment will save more than the original investment in a single year, after deducting all operating, maintenance, depreciation and carrying charges, when the operation of the machine is compared with manual methods. On the other hand, there are cases in which little or no saving can be shown when the comparison between machine and manual methods is shown independently for each year; yet if the study is extended to include a period of years, the economy of the equipment becomes apparent. This is illustrated by mechanical tie-tamping for, all costs included, there is frequently little difference in cost between power tamping and hand tamping. But, if the cost of the two methods is taken over a period of years corresponding to the intervals between general surfacings, and the cost of all intermediate surfacing is included, the economy of machine tamping cannot be denied, while the riding condition of the track will be better.

It is not always so easy to demonstrate that where an operation is already fully mechanized, still further savings of sufficient magnitude can be made by replacing the existing equipment with machines of more modern design, to warrant the substitution of the new machines and, if needed, a revision of the methods of handling the work. In his testimony before Committee 9 of the Wage and Hour division, Department of Labor, which is abstracted on a later page, Robert Faries, assistant chief engineer-maintenance, Pennsylvania, showed that the continued use of obsolete equipment may, in some applications, be relatively more expensive than manual methods in others. In proof of this statement, he showed that by replacing rail-bound ditching equipment with modern off-track machines, a sum equal to the cost of the later equipment can be saved in a single year.

Again, some machines may show only slight savings when used alone; yet when employed with other equipment may demonstrate much greater economies. Others may be suited for large operations only and may, therefore, be more expensive than hand labor if used on smaller jobs. Still others are designed primarily for the smaller jobs and may be equally unsuited for large work.

It is obvious that some factors must be given weight in selecting all work equipment for railway maintenance. The first of these is the suitability of the machine for the work it is expected to do; the second is its dependability, for a machine that is frequently out of commission may be more costly than no machine; the third is the simplicity of the mechanism, for complicated machines may be difficult to operate and costly to repair; and the fourth is its mobility, for equipment that is not mobile may sometimes be more of a hindrance than a help.

Being assured that the physical characteristics and design of the equipment are satisfactory, the next consideration is the financial return that can be expected from its ownership. Some of the elements that must be considered have been mentioned. Sometimes the information upon which a decision must be based can be obtained only through experience with the particular equipment under consideration, in which event it may be advisable to purchase one or two units for trial, or the purchase can sometimes be based on past experience with other similar equipment.

One point stands out clearly, however, and that is that obsolescence is seldom given the weight that its importance warrants. In recent years budgets have been so restricted that maintenance officers have been constrained to select those units of work equipment that would give the highest return on the investment, or for which there was the most pressing need, irrespective of savings. Furthermore, even an obsolete machine will ordinarily demonstrate a saving over manual labor, and this, combined with a reluctance to make retirements for accounting reasons, has prevented adequate consideration of obsolescence and the blight it may place on economy in maintenance. It will be worth while to give obsolescence greater consideration when selecting work equipment, for too many outmoded machines are now in service.

Soft Roadbed

Is Demanding Increased Attention

THOSE who today lay many of the woes of the track forces to the early methods of roadbed construction are usually on sound ground, because it is a certainty that if as much consideration had been given in the early days of railway construction to the permanent stability of the roadbed as has been given in recent years on the relatively few important sections of new line that have been built, many of the present-day "headaches" of track maintenance officers would be avoided, and current track maintenance costs at many points would be materially less than they are.

There are many reasons for the shortcomings of early roadbed construction as compared with recognized good practice today, including the rapidity with which the railways expanded, limited available funds, unfamiliarity with much of the territory traversed, and the lack of effective grading equipment and of present-day knowledge of soils. However, whatever the reasons may have been, and regardless of their validity, the fact remains that most of the problems of maintenance officers today in the way of an unstable roadbed and track structure are

traceable directly to these shortcomings. That this subject should be in the minds of maintenance men at any time is not surprising because unstable sections of roadbed are known to all of them and are invariably a source of special concern and expense. And that the subject should be especially in mind at the present time is readily understandable, when it is realized that many long-existing sections of soft roadbed are today, under present-day, heavy, high-speed train operation, demanding special attention when the railways sorely need the funds available to them for improving their track structures generally. Unfortunate as this situation may appear to be, it may prove to be not without large compensation, because under any form of operation, and especially under operation demanding a strong track structure, unstable roadbed is costly to maintain, and many stabilization projects carried out in the past have proved to be highly profitable investments.

The most effective and economical method of stabilizing the roadbed at any particular location demands the most careful study of the subgrade conditions involved and of the various methods that have been employed in roadbed stabilization work. With the presence of water usually the most important factor contributing to unstable roadbed conditions, it is not unnatural that subdrainage of one type or another should be given first consideration. Where the installation of suitable subdrainage appears to be impracticable or excessively costly because of local conditions, methods of confining and consolidating the roadbed, or of spreading the track load over it, have proved effective and relatively economical. In fact, more than one road, encountering such conditions in cuts, has made extensive use of cull ties, driven vertically at the ends of the track ties. At other points, and especially in cases of unstable fills of considerable height, they have driven lines of piles or rails along one or both sides of the track, as necessary, to confine and give lateral support to the embankment material, and at still other points where subdrainage would have been difficult, one road has experimented extensively with pre-cast concrete subgrade slabs and timber subgrade mats—all, it is said, with successful results.

In addition to the above methods, many instances are on record of successful "shooting" of the subgrade to break up planes of slippage and to open up drainage cracks in underlying rock, and several sections of cement—or asphalt-grouted roadbed, to distribute the track load, are under test, with the primary purpose of overcoming soft roadbed conditions.

The determination of which of the foregoing methods of stabilization is best adapted and most economical for any particular location can be made only by a most careful study of local conditions. It is entirely possible that under certain conditions none of them would be fully effective, permanent, and justifiable from the standpoint of the savings effected. However, maintenance men have not discharged their responsibility in this regard until this fact has been determined at many points that have long been neglected. It is certainly not to their credit to be able to cite sections of soft roadbed that have been a source of trouble and added expense for many years, unless the adverse conditions which prevailed have been corrected. At the same time, with the present knowledge and experience that are available in effective roadbed stabilization practices, those who fail to work out the solution of their soft roadbed problems, and to promote them vigorously with their managements for attention in the light of the savings and improved track conditions to be effected, can with little justification be critical of their predecessors of earlier years whose handicaps and shortcomings set the stage for the development of many of these problems.

Joint Ties

Should They Be Specially Selected?

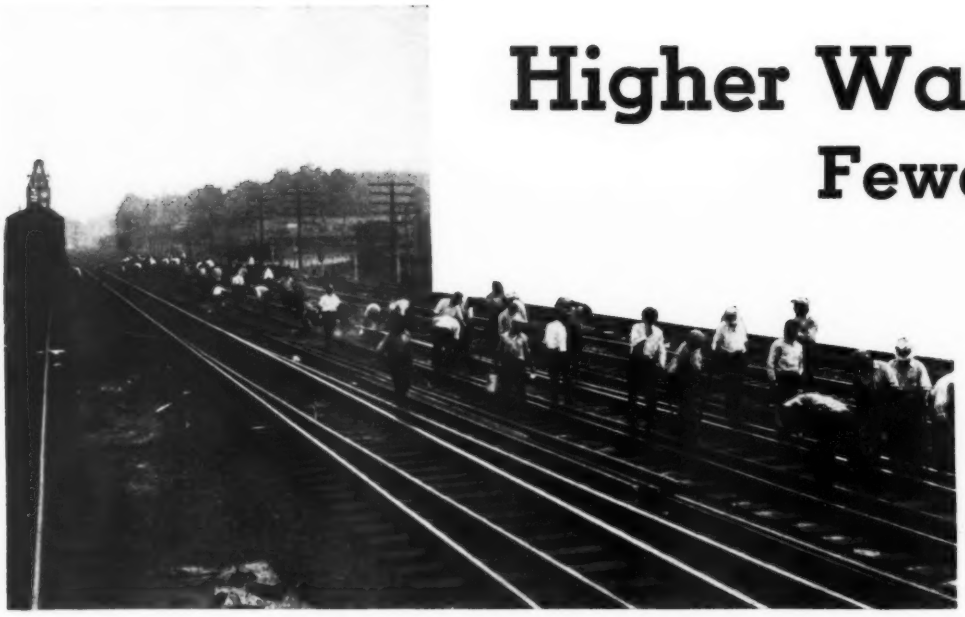
IF questioned, experienced trackmen will almost invariably advocate the selection of the largest ties, except those that may be abnormally wide or thick, for use as joint ties. In view of the changes that have occurred in track construction and track materials in recent years, it seems worth while to inquire whether this practice has a sound basis or whether it is merely a survival from a former day and from a number of conditions that do not exist at the present time.

It is not difficult to trace the origin of the practice. In the days when most track was laid with even joints, the joint fastenings were weak and much track was unballasted, or the ballast that was used was poor in quality and generally inadequate as to quantity. At that time the support of the rail ends was one of the major problems of the trackman, so that it was the universal practice to select the largest ties for use at the joints, and it was generally considered that the larger they were the better they were. As track construction has improved, higher rail sections have replaced the lighter rail of the former day and the new designs of joint fastenings that were made possible by greater fishing depth, have brought the strength of the joint closer to that of the rail. In addition, broken joints have almost entirely superseded the even joints of the former day.

It should be kept in mind that the improvements in track construction included drainage of the roadbed, more and better ballast, treated ties, tie plates, anti-creepers and heat-treated bolts and joint bars, as well as heavier rail and better designs for the joint bars. They also included more rational specifications for crossties, whereby the wide variations in cross-sectional dimensions were greatly reduced. More recently these specifications have been revised to eliminate the tolerances below and reduce those above the specified sizes. It is evident that through these improvements, a more uniform and dependable support for the track has been provided, and that the strength of the joint more nearly approaches that of the rail.

It is equally evident that, as a result of these developments, the necessity for increased support at the joint, as compared with the remainder of the rail, no longer exists, so far as the selection of ties for this purpose is concerned. Furthermore, if the ties conform to the A.R.E.A. specifications, there will be so little difference between the largest and the smallest ties, assuming that they are all of the same grade, that there will be little incentive to expend time or effort in making a selection for use at the joints. In fact, if the track is laid with heavy rail, is well ballasted and is supported on a stable roadbed, no expense can now be justified for segregating ties for the purpose of using the larger ones at the joints.

Higher Wages— Fewer Men—



For Each One Cent Increase in Wages A Certain Number of Track Men Will Be Thrown Out of Employment

FOR each one-cent increase in the minimum wage for section, extra-gang and other maintenance of way employees, a definite number of men will be thrown out of employment. Since the amount of work to be done remains the same, power machines and tools must be substituted for the displaced employees. It follows, therefore, that for each one-cent advance in the minimum wage, a definite amount of work equipment will be purchased. When the minimum wage reaches 40 cents an hour, 7,118 men will be displaced by mechanization of the maintenance forces on the Class I roads alone, and the corresponding additional investment in work equipment to replace the dismissed employees will amount to $4,270,962.

These statements were made by Robert Faries, assistant chief engineer—maintenance, Pennsylvania, in testimony presented for the railways of the country as a whole, at a hearing before the Railroad Carrier Industry committee (Committtee No. 9) of the Wage and Hour division, Department of Labor, which conducted hearings during the latter part of February and the early part of March, to determine its recommendations as to the minimum wage on the railways, up to a possible level of 40 cents an hour, which, in the language of the Fair Labor Standards Act, under which the hearing was held, "will not substantially curtail employment." Mr. Faries' testimony was substantiated and reinforced by other witnesses, including Dr. Julius H. Parmelee, director, Bureau of Railway Economics; G. R. Smiley, chief engineer, Louisville & Nashville; and F. S. Schwinn, assistant chief engineer of the Gulf Coast Lines and of the International-Great Northern.

Employment Reduced

Preceding Mr. Faries on the stand to lay the foundation for his presentation, Dr. Parmelee pointed out that in the past the greatest relative reduction in employment has occurred among those classes of employees that have received the greatest relative increase in wages, and that, relatively, the reduction in employment generally exceeds the increase in wages. In substantiation, he showed that from 1928 to 1939, the average hourly compensation for maintenance of way employees increased 17.3 per cent, and that during the same period the number of such employees was reduced by 49 per cent, while the total hours paid for decreased by 52.2 per cent.

Doctor Parmelee also pointed out that the general trend in railway employment has been downward in recent years. Further emphasizing the effect of wage increases on railway employment, he presented figures to show that the decrease in employment in the maintenance groups during the period from 1928 to 1939, amounting to 49 per cent, was higher than the average, 40.4 per cent, for all groups and, likewise, that it was greater than for any other group. "The significance of this cannot be over emphasized," he said, "for maintenance of way employees, with the lowest average hourly compensation, showed the largest relative increase in hourly compensation and at the same time experienced the greatest relative reduction in numbers. Curtailment of employment clearly exerted its most serious effect on the lowest rated employees, and those employees were the ones that, during the period under consideration, had received the greatest relative increase in compensation."

Explaining why slight changes in wage rates produce far greater effects on railway employment than on employment in other industries, Dr. Parmelee presented figures showing the relationship of total payrolls to gross revenues of the railways and of various other industries. On the railways, the ratio of total payroll to gross revenue was shown to be 47.6 per cent, compared with an average of 21.2 per cent for other industries.

Railway Prices Rigid

"Furthermore," said Dr. Parmelee, "the pricing structures of manufacturing companies are geared to withstand fluctuations in the cost of materials as well as changes in labor costs. Ability to pass added costs on to wholesalers, retailers and consumers, as well as the ability to vary the pattern of its manufacture, constitutes a safety valve for cost increases. Flexibility in the price structure gives further advantage.

"On the other hand, the railways operate under quite different circumstances. They use no raw materials, as the term is understood in manufacturing. The price structure is rigid, and is regulated strictly by governmental agencies. There is no cushion of marketing mechanisms to absorb the shock of increased costs. Service may not be curtailed except within narrow limits controlled by regulative

More Machines

Off-Track Equipment Demonstrates a High Degree of Economy

This article summarizes the testimony of Robert Faries, assistant chief engineer—maintenance, Pennsylvania, before the Wage and Hour division of the Department of Labor, in which he showed that any increase in the minimum wage of railway forces at this time will defeat the fundamental purpose of the Wage and Hour law, which is to increase minimum wages without substantial curtailment of employment. Mr. Faries made it clear that any increase must be offset by the increased use of work equipment, improved materials or added capital investment to effect compensating economies, and that this is bound to reduce the need for labor

agencies; it may not be cheapened, the standard being set by regulation and by the exigencies of competition.

"For these reasons, any savings that may be made must come principally in operating expenses and in labor costs. Because of this, any increase in the minimum wage rate will have the effect of reducing employment. Railway operations are budgeted closely and carefully; they must be to avoid financial disaster. Conditions in the railway industry are thus quite different from those prevailing in the manufacturing field; on the railways, an increase in one type of cost means that a cut must be made in some other item of expense; it must be so, if both ends are to be made to meet.

Must Increase Economy

"The railways have been confronted with economic and competitive conditions during the last decade, that have necessitated every possible effort to increase the economy and efficiency of operation. They have achieved this to a considerable degree by improved methods of operation, involving among other things the displacement of men with machines. Such a policy has been stimulated by a generally rising scale of wages for employees.

Many Roads Bankrupt

"Twenty roads will be affected principally by an increase in the minimum wage. These 20 roads have a larger percentage of operated mileage in bankruptcy than the remaining carriers. The impact of an increase in the minimum wage would be from seven to eight times as great on their net railway operating income as on the remainder of the Class I group. They have no net income whatever from which to meet an increase in the minimum wage, but have suffered a net deficit in each consecutive year since 1932. These roads, above all others, faced with the bulk of any increase in minimum wages, will be driven by lack of net income to seek ways and means of mechanizing their operations to the greatest possible extent."

Mr. Faries introduced records showing that in 1939, the straight-time earnings for section and extra-gang laborers on Class I roads ranged from 25 cents an hour on certain roads in the Southern region to levels of from 40 to 50.2 cents in the remaining regions; that during the same year the man-hours paid for track labor ranged from 665 to 1,769 per mile of main track operated; and that the investment in work equipment ranged from $10.08 per mile of main track operated to $999.42, with an average for all roads of $314.54 per mile, and with the majority ranging from $150 to $450 per mile.

These same data were given by years for every year from 1925 to 1939, and were estimated for 1940, except the man-hours per mile of main track, on the basis of information given by the roads. Mr. Faries confined his studies to the track forces, principally to simplify his presentation, but also because these forces will be affected to the greatest extent by the result of the proceedings, making it clear, however, that the principles underlying his discussion apply to all other classes of railway employment. The information he presented covered 111 Class I roads representing 93 per cent of the total main-track mileage of the country. In addition to the foregoing, information was also obtained from these roads as to the amount of investment that can be justified economically in maintenance of way machines at the present wage, and the portion of this which is programmed for 1940; and the additional investment that would be made necessary by reason of an increased minimum hourly wage.

Wages Up, Employment Down

"As wage costs rise," Mr. Faries testified, "the railways, faced with a ceiling of rates for the service they perform and having, therefore, a fixed gross revenue that varies only with the amount of business offered, are forced, in a struggle for existence, to resort to all possible means to avoid increasing current unit costs. The effects of the economic depression and increasing losses of traffic to subsidized competitors, have intensified this problem.

"Allotments for maintenance must not and do not exceed a definite or fixed portion of the total operating revenues, which for some years has been approximately 11 per cent. There is a definite relationship between labor and material used under these maintenance allotments. For this reason, the allowance for labor is

a definite proportion of the maintenance allotment.

"In attempting to solve the unemployment problem on the railways the most vital factor has generally been overlooked. This fundamental thing is employing power. The ability of the industry to employ has decreased in recent years, and if the forces working adversely continue, the employing ability of the industry will be further curtailed seriously."

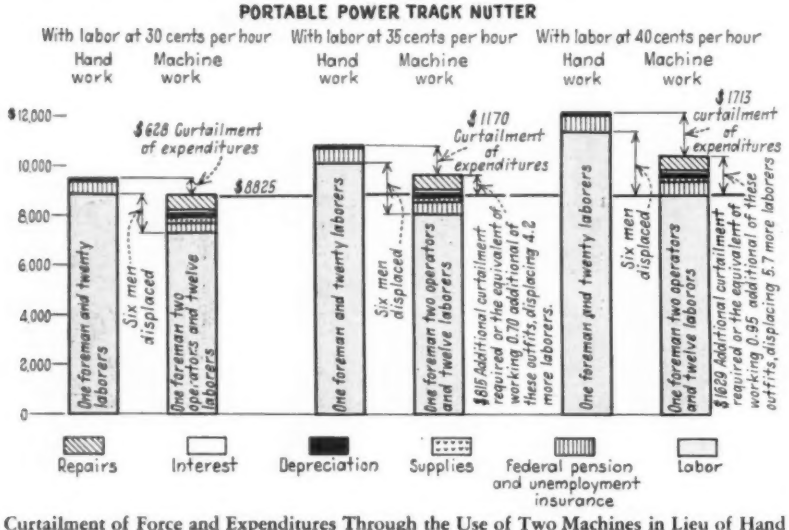
Divides into Two Groups

Mr. Faries then presented charts showing graphically the extent of the use of work equipment since 1925, including the amount of such equipment provided for in the budgets for 1940. For the purpose of showing more clearly the effect of wage increases, the statistics were divided into two groups, that is, those upon which the straight-time earnings were more than 33 cents an hour, designated as Group 1; and Group 2, including all those roads reporting these earnings as 33 cents or less an hour. He showed that on Group 2 roads the investment in work equipment per mile of main track was $137 in 1925 and that it will be $188 in 1940, an increase of $51, or 37 per cent. During this same period the earnings of track labor on these roads increased 4.8 cents an hour, or 17.8 per cent. He pointed out that, despite the wage reductions that were in effect during a part of the period, which obviously reduced the incentive to purchase work equipment, and despite relatively heavy retirements as a result of wear and obsolescence, the investment in work equipment per mile of main track increased $10.60 for every one cent increase in wages.

Similarly, he showed that in 1925, the corresponding investment of the roads in Group 1 was $221 a mile and that with the completion of the 1940 program this will be increased to $348 per mile of main track. This increase amounts to $127, or 58 per cent. During the same period wages on these roads increased 5.7 cents an hour, or 15.4 per cent. Emphasizing that in this case the increase was at the average rate of $22 a mile for each one cent increase in wages, from 37.1 cents to 42.8 cents an hour, or slightly more than double the $10.60 increase per mile for the Group 2 roads, on which wages increased from 27 to 31.8 cents an hour, he pointed out that there was fully twice the incentive to use machinery in maintenance as the result of the 10 to 11 cents differential in the hourly wage.

Mr. Faries pointed out that while mechanization is a large and important factor in reducing the number of man-hours required to maintain track, increased investment to provide better materials, stabilized roadbed and other improvements in track and roadbed construction, may also have the same effect. He presented figures to show that in only one year—1936—since 1930 have the man-hours per track mile of the Group 1 roads exceeded those for the Group 2 roads, the figures for this year being 1,206 and 1,186 man-hours, respectively. "This result," said Mr. Faries, "occurred in the face of the fact that the traffic density of the Group 1 roads was consistently much higher than on the Group 2 roads. There must be but one reason for this, namely, the effect of the greater use of machinery, heavier rails, stabilization and other improvements in track, has been to permit the Group 1 roads to maintain their tracks with fewer men per mile, despite a heavier traffic density. Other things being equal, employment will vary with the investment in machinery per mile."

Mr. Faries stated that the roads in Group 2 reported that in progressing from an average wage of 24.5 cents in 1936 to an average wage of 31.8 cents in 1940, an increase of $498,458 additional investment in work equipment has been made or is programmed immediately. Since the average investment for mechanization equivalent to the displacement of one man for a full year is $600, this increased investment has had, or will have in the immediate future, the effect of displacing 831 men. As a result of the recent increase in the minimum wage to 30 cents an hour, the roads in this group indicated that they would be justified in making a further investment in power machines and tools to the extent of $612,992. Similarly, he said that Group 1 roads affected by this minimum wage reported that they are warranted in making further investments totalling $64,366. These additional investments, resulting principally from the recently increased wage minimum, will eventually displace an additional 1,129 men, this being the result of increases already granted.


PORTABLE POWER TRACK NUTTER
With labor at 30 cents per hour
With labor at 35 cents per hour
With labor at 40 cents per hour
Hand work
Machine work
$12,000
10,000
8,000
6,000
4,000
2,000
0
$628 Curtailment of expenditures
$8825
$1170 Curtailment of expenditures
$1713 curtailment of expenditures
One foreman and twenty laborers
Six men displaced
One foreman two operators and twelve laborers
One foreman and twenty laborers
Six men displaced
One foreman two operators and twelve laborers
$815 Additional curtailment required or the equivalent of working 0.70 additional of these outfits, displacing 4.2 more laborers.
One foreman and twenty laborers
Six men displaced
One foreman two operators and twelve laborers
$1029 Additional curtailment required or the equivalent of working 0.95 additional of these outfits, displacing 5.7 more laborers
Repairs
Interest
Depreciation
Supplies
Federal pension and unemployment insurance
Labor

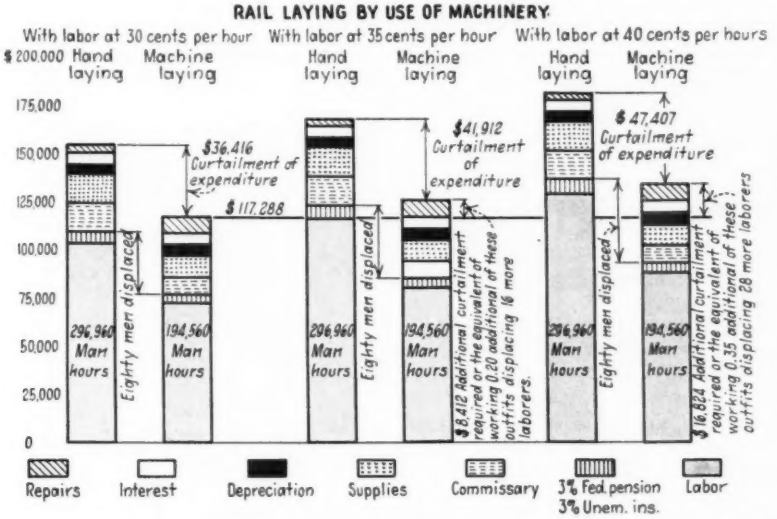
Curtailment of Force and Expenditures Through the Use of Two Machines in Lieu of Hand Wrenches for Removing and Replacing Nuts in Changing Joint Bars

Specific Applications

Turning next to specific applications of machinery to maintenance tasks, Mr. Faries described in detail a number of power machines and the way they are used in maintenance work, and demonstrated by means of charts and calculations their economic value at various wage levels up to 40 cents an hour. He explained that in practice, when considering projects for mechanization, there is less incentive to invest in machines that will give less than 15 to 20 per cent return on the investment, than in equipment that will give greater returns. "Thus," he said, "there are a number of borderline cases, where even a slight increase in the economic value of certain machines, resulting from a higher labor wage, will put them in the economically justified class."

He took as his first example bolt tighteners in connection with an out-of-face replacement of joint bars. He showed that a gang consisting of 1 foreman, 2 operators and 12 laborers, equipped with 2 of these machines, costing $829 each, working for a period of 160 days, could complete a certain amount of work, while to do the same amount of work in the same time with hand wrenches would require 1 foreman and 20 laborers: Thus the two machines displace six men. At

30 cents an hour, the total cost of the manual operation would be $9,453, including payroll, supplies and federal pension and unemployment insurance, while at the same wage rate the cost of the mechanized operation would be $8,825, including payroll, repairs and depreciation on the machines, interest on the investment, supplies and federal pension and unemployment insurance. This is a difference of $628 in favor of the power machines and represents their economic value when the average wage is 30 cents an hour.



Curtailment of Force and Expenditures Through the Use of Machinery in Laying Rail in Lieu of Hand Work, Working 160 Days a Year

Mr. Faries pointed out that the displacement of the men in this operation, as in all others, is brought about by the use of the machines, and that it has no connection whatever with the rate of wages. On the other hand, an increase in the wage rate provides the incentive to employ the machines, and this incentive is increased as the wage level rises. This is demonstrated by the fact that in exactly the same manner as before, Mr. Faries showed that the economic value of these machines becomes $1,170 when labor is receiving 35 cents an hour, and $1,713 when it has risen to 40 cents. The intermediate economic values were shown to be $737, at 31 cents; $845, at 32 cents; $954, at 33 cents; $1,062, at 34 cents; $1,279 at 36 cents, $1,388, at 37 cents; $1,496, at 38 cents; and $1,605, at 39 cents.

Another Factor Appears

Mr. Faries pointed out also that as wages rise the cost of the work increases, whether done manually or mechanically. He showed that at 35 cents an hour the economic value of the machines was $1,170. However, at 35 cents, the cost of the mechanized operation is $9,640, or $815 more than it was at 30 cents an hour. "Assuming, as is perfectly proper," he said, "since the expenditures for labor are practically fixed, that $8,825 is all the money that is available for this job, when the maintenance engineer is confronted with an increase of 5 cents in his wage rate, he will be compelled to curtail some other job by this amount. Obviously he must get this amount through the mechanization of some other work or perhaps make an equal saving in labor by laying heavier rail.

In the same way Mr. Faries showed that at the 30-cent rate, the economic value of a power rail drill, costing $632, is $190, and that this value increases to $395 when the rate reaches 40 cents. These figures are based on a working period of only 60 days during the year. If the machine is employed for a longer time, its economic value for the year will be increased correspondingly.

Mechanizing Rail Laying

In the same manner as before, Mr. Faries showed that in laying rail, a gang working 160 days during the year, having a full complement of power machines, consisting of spike pullers and spike drivers, bolt tighteners for stripping the old rail and for tightening the bolts on the new rail, adzing machines, a rail crane, an air compressor, power bonding and power rail drills, an oxy-acetylene outfit and a rail grinder, will need 80 men less than will be required for a completely manual operation. The first cost of the equipment listed by Mr. Faries will be $34,273 and it will have an economic value of $36,416 at 30 cents an hour; of $41,912 at 35 cents; and of $47,407 at 40 cents. On the other hand, as the wage rises from 30 to 35 cents, an additional curtailment of $8,412 will be necessary; and at 40 cents, this will have increased to $16,824, an equivalent displacement of 16 and 28 more laborers, respectively.

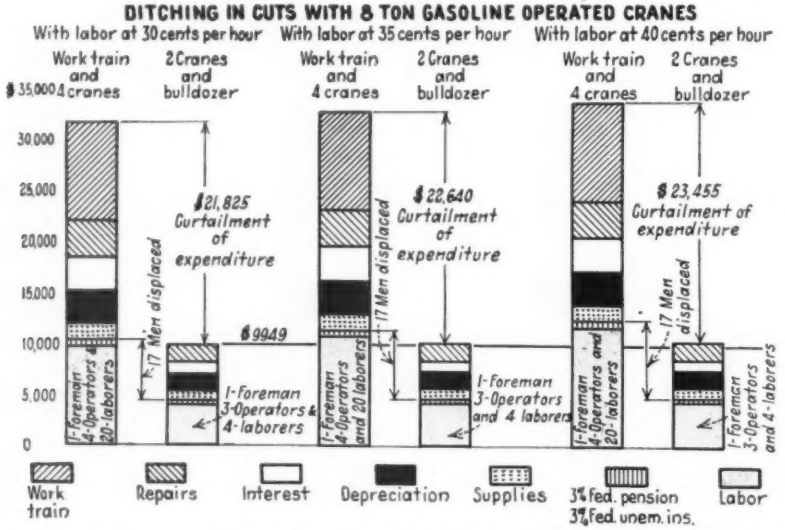
Mr. Faries stated that unless it became possible to mechanize still further the rail-laying operation a sufficient amount to offset the additional curtailment, this will have to be secured through mechanization of other work or by capital investment in heavier rail, better ballast and stabilization of the roadbed. If it cannot be met by any of these means, the only alternative is an arbitrary reduction in the track forces.

In like manner he found the economic value of a rail-bound light crane when used for such miscellaneous purposes as loading and unloading material, ditching, laying rail, etc., to be $3,133 at the 30-cent wage; and $4,812 at the 40 cent rate. Used in this way, such a machine will displace 11 men. According to Mr. Faries, the original cost for machine tamping is slightly more, all costs included, than for hand tamping. However, records kept on the Pennsylvania show that when 131-lb. rail is laid and the traffic amounts to approximately 16,000,000 gross tons annually per mile, machine tamping will last six years, while hand tamping will last only four years, these being the intervals between general surfacings. In addition, about 30 per cent more intermediate or spot surfacing is necessary on the hand-tamped track than on that tamped with machines.

To obtain the economic value of this equipment, and basing his calculations on a 12-tool outfit, costing $7,269, and working 190 days during the year, the output for one of these outfits for one season was calculated and reduced to an annual cost. Then the annual cost of the intermediate work was added. When this was done for the manual operation also, it was found that the economic value of the tamping equipment is $1,186 at the 30-cent wage rate, and $1,678 at the 40-cent rate, and that three men will be displaced. "This," said Mr. Faries, "is one of the border-line machines, for it will be noted that at the 30-cent wage the annual saving is 16.3 per cent of the cost of the machine and appliances, but at the 40-cent rate the saving is 23.1 per cent." On the same basis, he showed that the unit tamper, costing $299, has an economic value of $187 at 30 cents and of $493 at 40 cents, and four tampers in a single outfit will displace two men.

As his next example, Mr. Faries

showed that even where an operation is already fully mechanized it is possible to make worth-while savings through the use of more modern machines. He illustrated this by citing a ditching operation in which four rail-bound cranes with clamshell buckets, eight dump cars and a work train had been engaged in ditching over a period of 120 days—six months—during the year. Through the substitution of two crawler-mounted draglines and one tractor bulldozer, the entire outfit costing $22,301, a reduction in cost of $21,825 was possible at the 30-cent rate, and the potential curtailment at 40 cents was found to be $23,455. The small increment in the reduction between the 30 and the 40 cent rates in this case is explained by the fact that the more modern outfit requires the services of only a small gang consisting of 1 foreman, 3 operators and 4 laborers, so that the laborers only will be affected by the rise in the wage level. The large saving which the more modern equipment demonstrates is made up principally of the elimination of the work train and the displacement of 17 men.

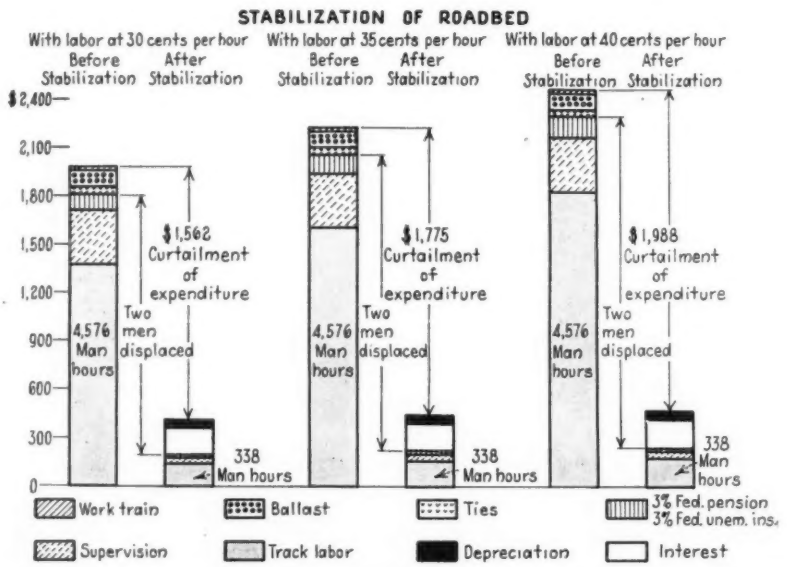


Curtailment of Force and Expenditure Through the Use of Off-Track Ditching Equipment in Lieu of Railbound Equipment, Working 120 Days a Year

Similar comparisons were made for ballast discers, costing $1,242, which were shown to have an economic value of $10,957 and $14,660, at the 30 and 40-cent rates respectively. It was stated that one of these machines will displace 85 men. It was also shown that a ballast scarifier, costing $8,097, will displace 90 men and will have an economic value of $18,173 and $24,516, respectively, at the 30 and 40-cent rates. Mr. Faries also showed that a weed burner costing $9,354 will displace 150 men and will have an economic value of $25,402 and $34,815 at the respective rates. He also placed the economic value of a weed mower operating from the track, and costing $1,821, at $3,569 or $5,095, depending on whether the labor rate was 30 or 40 cents.

Turning to materials, Mr. Faries, showed the effect of installing improved materials having increased life. Taking ties first, he showed that by preservative treatment to extend tie life from 8 years to 20 years, and calculating the cost on an annual basis, there is a reduction of 225 man hours and of $165.55 per mile of track at the 30-cent rate; and when the rate advances to 40 cents, the reduction in man-hours will be the same but the reduction in total cost will be $188.40 annually. Similar studies were made to determine the effect of increased investment in rail, that is, the effect on employment of the use of heavier rail, the comparison being made between 100 and 131-lb. rail carrying an annual traffic of 16,500,000 gross tons per mile. In making these studies, the costs for each weight of rail were reduced to the annual basis for both investment and maintenance at each rate of wages. It was found that the use of the heavier rail increased the annual investment per mile of track by $75, but reduced the annual expenditure for maintenance by $95. Likewise, at the 35-cent rate these figures become $72 and $113; and at the 40-cent rate they are $69 and $133. This increase in the weight of rail will have the effect of displacing one man for every six miles of the heavier rail.

Turning to stabilization of the roadbed, Mr. Faries emphasized that each case is an individual one and must be considered on its own merits in the light of the local conditions. He indicated, however, that all such projects have inadequate drainage as the fundamental cause of the instability and that the basic cure, drainage, is the same for all. He stated, however, that in some cases stabilization has been accomplished by confining the roadbed between rows of piling driven parallel to the track and that in others the same results have been attained by means of timber grillages beneath the ballast to reduce the unit load and distribute it over a greater area.



Curtailment of Force and Expenditure Through Improvement in Drainage to Stabilize 480 Lin. Ft. of Roadbed.

He cited a stabilization project at Lanham, Md., which at 30 cents an hour represented a capital expenditure of $3,438 and at 40 cents an ex-

penditure of $3,626. The improvement in track conditions was sufficient to reduce the labor required for maintenance on the 480 lin. ft. of roadbed involved, by 4,117 man-hours annually or the equivalent of two men. At the 30-cent rate this was a reduction of $1,562 and at the 40-cent rate $1,988. These reductions represented returns of 45.4 and 54.9 per cent, respectively, on the capital investment.

Mr. Faries then took an assumed railroad having 1,200 miles of main track and assigned the proper number and types of power machines to give a balanced and economical operation. He showed the amount of investment required to provide 6 bolt tighteners, 2 power rail drills, 4 adzing machines, 2 rail cranes, 8 tie tamping outfits, 20 unit tie tampers, 2 draglines, 1 tractor bulldozer, 2 ballast discers, 1 ballast scarifier, 1 weed burner, 2 track mowing machines, 4 power jacks and 2 power tampers. This mounted to $160,970, and it was calculated that the use of this equipment would effect an annual reduction of 68,100 man days in the labor required, compared with manual operations. Assuming 255 working days per year, this showed that 267 men would be displaced by the equipment listed. Then dividing the investment by the number of men displaced, it was found that an investment of $603 in work equipment will displace one man.

Taking the reduction in the number of men which will be required to meet any increase in the minimum rate by increments of one cent an hour from 30 to 40 cents, and applying the foregoing figure of $600 to be invested in work equipment for each man displaced, Mr. Faries found that the reduction in employment and the investment in equipment will be as shown in the accompanying table. In concluding his testimony, Mr. Faries said that "when there is a better and cheaper way to do work, that is the way it should be done. The pressure which forces mechanization increases with each one-cent increase in wages. The necessity for the adjustment to such increases should come slowly and gradually, to avoid any cumulative impact of mechanization on employment. This should be the desire of both the men and management."

Effect of Increasing Wages on Employment and on Investments in Work Equipment

Minimum rate cents per hour	Amount of additional investment	Total number of men displaced
31	$ 375,976	627
32	639,228	1,065
33	915,439	1,526
34	1,207,671	2,013
35	1,647,227	2,745
36	1,974,649	3,291
37	2,370,472	3,951
38	2,870,260	4,784
39	3,616,490	6,027
40	4,270,962	7,118

Cleaning Sewers With Muriatic Acid Is Effective

THE problem of keeping sewers open at locomotive terminals is one which often presents serious problems and entails considerable expense. Such sewers are usually forced to carry a wide variety of matter such as cinders, sand, floating ashes, oil, waste and frequently water containing a large proportion of incrusting solids, which deposit readily if conditions are favorable. These conditions are complicated further by the fact that sewers at terminals frequently must be constructed with a normal or slightly less than normal grade line and usually have a number of intercepting sewers, which empty into them, all tending to create conditions which are favorable for the depositing of solids.

Overcome Serious Trouble

To correct such conditions, a method of cleaning sewers at locomotive terminals by using muriatic acid has been developed and used with economy and great success at a number of points by the Chicago, Rock Island & Pacific. This method was first tried at Joliet, Ill., where the sewer from the mechanical cinder hoist was giving a great deal of trouble. This sewer consisted of 12-in. vitrified tile, 800 ft. long, which lay approximately 8½ ft. to 11 ft. below the surface of the ground. The sewer line was provided with eight man-holes approximately 150 ft. apart, and two intercepting sewers from the roundhouse and turntable emptied into it. Conditions became so bad at this point that the sewer had to be rodded out every four or five days to keep it open. Even with this amount of work, the opening remained small and the sewer did not drain well. The expense of rodding the sewer every few days was so great that it was decided that something had to be done.

The cost of relaying the entire sewer line was considered, but this amounted to a considerable sum and it was suggested that the sewer might be cleaned by using commercial muriatic acid to loosen up the incrustation that was blocking the sewer so that it might be flushed out into the man-holes where it could be removed. The experiment was first tried on 200 ft. of the line between two man-holes. This portion was blocked off and 25 carboys of commercial muriatic acid were poured into the line through an iron pipe extending from the top of the ground to the sewer line. The acid was left in the tile line for 12 hr. and at the end of that period the line was flushed with water through a fire hose with 40-lb. per sq. in. pressure. After flushing, the line was found to be perfectly clean and the balance of the 600-ft. of sewer line was cleaned in the same manner. From the entire 800 ft. of sewer 38 wheelbarrow loads of fine cinders, sand and other accumulated refuse was removed.

The work at Joliet was so successful that it was decided to use muriatic acid to clean locomotive terminal sewers at a number of other points where conditions had been troublesome. Nine hundred feet of sewer line was cleaned at Council Bluffs, Iowa; 300 ft. at Manly, Iowa; 700 ft. at Sheffield, Ill.; and 800 ft. at Cedar Rapids, Iowa. All of these locations were in territory where coal-burning locomotives are operated. The other sewers were cleaned as successfully as the Joliet sewer, with large savings as compared to other methods. In this work the cost of cleaning averaged approximately 11 cents per lin. ft. but varied somewhat with sewers of different sizes and with varying amounts of accumulation.

In the use of muriatic acid for this work, a great deal of care was taken to protect the workmen from burns due to the acid and also against the possibility of gas accumulations in the man-holes or sewers after treatment with the acid, until the line had been properly flushed and cleared of gas.

For the information contained in this article we are indebted to John E. Tiedt, engineer of water service of the Rock Island, with headquarters at Chicago, under whose direction this work was carried out.

Rail Laying Gang Relays 2

This article describes the effective organization and methods employed on the Chicago, Rock Island & Pacific in relaying rail in 1939, in which a gang of 125 men, most of whom had from two to four years previous extra-gang experience, relayed an average of about 20,000 ft. of rail each working day during the entire rail laying season, lasting several months

When the Work Was Well Under Way, the Gang Was Usually Spread Out Over a Mile or More

In 1936 the Chicago, Rock Island & Pacific revised its standards for relaying rail on both its main and branch lines and, at the same time, altered its extra gang organization and system of doing this work. The present system, based on the use of mechanized extra gangs of 120 to 130 men, has resulted in greatly increased production and considerable economy compared with previous work, one such gang having relayed an average of 20,000 ft. or more of rail per day for an entire season.

Quality Work With Speed

While many rail laying records have been set from time to time on various railroads, usually for a short period of time, such records have frequently been established only by sacrificing the quality of the work. The large production obtained on the Rock Island in its rail relay work is all the more outstanding from this standpoint, because the standards for this work have been raised during the same period that the new methods and organization have been evolved. The increased production secured is due to several factors, among which is the use of a variable type of gang organization which permits adjustments each day or during the course of the work to best meet changing conditions. This elastic or variable type of gang organization, combined with the practice of gaging at every third or fourth tie, and not full-spiking until near the close of the work each day, enables the entire gang to be occupied productively nearly every minute of its assigned hours.

The use of this type of organization on the Rock Island was to some extent made possible, or more effective, by the fact that a large proportion of the men in the gangs were veterans of several years service in extra-gang or section work, and each was skilled in at least several of the various rail laying operations. Other factors which have aided the production of the gangs were the elaborate planning and preparatory work, including the exact distribution of materials.

While an article could have been written around the work of any one of several of the rail laying gangs employed on the Rock Island in 1939, this article will be confined to the operations and methods of work employed by one of the gangs in replacing 35 miles of 90-lb. rail on the single-track Short Line of the Rock Island between Kimball, Iowa and Corydon. This territory, while not one of exceptionally heavy traffic, carries the streamlined Rocket trains operating between Minneapolis, Minn., and Kansas City, Mo., and a considerable freight traffic, as well as other passenger trains. It is "fast track," with time-card speeds on tangent track of 70 m.p.h. for the Rocket trains, 60 m.p.h. for other passenger trains, and 45 m.p.h. for freight trains. With the exception of the Rockets, two through freight trains and local freight service, most of the traffic over the line moves at night.

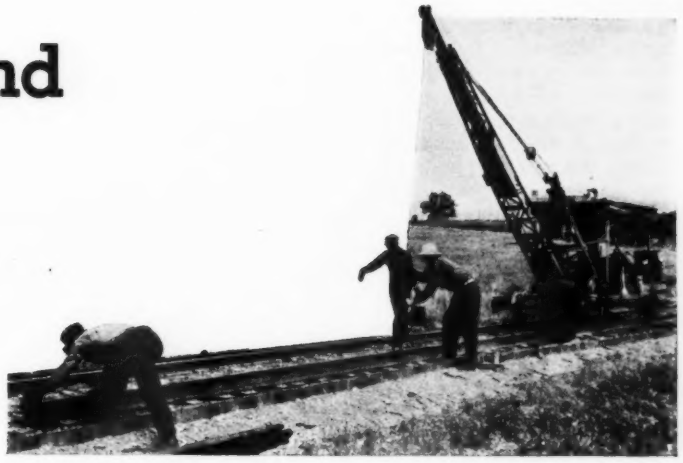
The track was relaid with new 112-lb. RE section, controlled-cooled rail, equipped with new joint bars of a four-hole, toeless design, 24 in. long, and new double-shoulder tie plates, 7½ in. by 11 in. in area, with a cant of 1 in 40. Two spikes were driven per tie plate on tangent track, and more, in accordance with Rock Island standards, were applied on curves, depending upon the degree of curvature. Six rail anti-creepers were applied to each 39-ft. rail to prevent movement in either direction, except that in some locations the anchorage was varied to meet special conditions. The ballast was gravel.

Preliminary Work

Prior to the unloading of the new materials, which was done from work trains, considerable preparatory work was done on the track in the interest of conserving the time of the rail laying force. The old rail was inspected in the track and marked with paint to identify it as Class 1, 2, 3, 4, or scrap. Furthermore, the entire territory to be relaid was measured carefully with a steel tape and record was made of the locations of all switches, road crossings, station grounds and other factors that might affect the progress of the work or demand special materials. From this record the exact amounts and locations of new rail of various classes and lengths, and of the fastenings and other materials needed, were determined.

on the Rock Island

Miles a Day



The Crane Crew Consisted of an Operator and Three Rail Men

All materials were unloaded exactly in the amounts needed. Short rails for switches and curves were unloaded at the proper locations and 66-ft. rails were provided for all important street and road crossings. The rail was unloaded with an air-operated rail unloader and set workwise, while all tie plugs, tie plates, joint bars, spring washers and bolts were unloaded in bundles or kegs at proper intervals. Closure rail for leads in all switches were cut to proper lengths and drilled for joints at the system rail yard and were shipped with the switch material, thus eliminating the necessity for cutting rails during progress of the work.

Spotted and Lined Ahead

Where necessary, section forces spotted and lined the track ahead of the rail gang so that, following the relay work, it would be in good line and surface until subsequent reballasting and surfacing operations could be carried out. The section forces also oiled the ends of the new rail, and then hung the joint bars loosely on the rear end of each rail, with one bolt applied in the end hole of the bars. In fact, all preparatory work that could be done to speed up and increase the efficiency of the actual relay work was done, except "eyeing out" the ballast under the rail between the ties to facilitate machine adzing. This work was left for the rail laying gang because the ballast section in this particular territory required very little of this work, and, for this reason, it could be done much more economically after the old rail had been removed.

General Method of Relay Work

Because of the considerable difference in height of the old and the new rail, which amounted to approximately 1¼ in. to 1⅜ in., the relay work was carried out under a slow order of 20 m.p.h. for Rocket trains and 15 m.p.h. for all other trains, and each night a slow order of 30 m.p.h. was placed on the track relaid during the day. This gave the tie plates a better opportunity to become seated properly on the newly adzed surfaces of the ties, with less possibility of short line kinks and uneven gage which might result from the slight shifting of the unseated tie plates if traffic were allowed to operate over them at high speeds. However, although slow orders were employed, every effort was made to clear the track and to avoid actually stopping trains. During the season, the gang usually worked 8 hr. a day, but in this territory, because existing train schedules permitted, the assigned working period was 9½ hr. Throughout the work, the practice was followed of relaying the rail continuously on one side during the day, always laying the line rail first, and dropping back the following day to relay that on the gage side.

Supervision

The rail laying work was carried out under the direct supervision of an assistant roadmaster, who was assigned to the extra gang for the entire rail laying season. He reported to the roadmaster and superintendent of the territory in which he was working and submitted reports to the district maintenance engineer, general superintendent, general manager and the engineer of maintenance of way of the system. Under the assistant roadmaster were an extra gang foreman, two assistant extra gang foremen and one timekeeper. From the standpoint of supervision, the gang was divided into two units, one ahead of the rail crane, and the other bemind it, each under the supervision of an assistant extra gang foreman. The assistant roadmaster and extra gang foreman paid particular attention to the operation of the rail crane but had general supervision over the operations of the entire gang.

Laying the Rail

The force under the first assistant foreman consisted principally of men distributing material, stripping the track, and adzing the ties. In this force, 6 men distributed new spikes and bolts, 4 men distributed the new tie plates at each tie, 14 to 20 men with claw bars pulled the spikes, 4 men with two bolting machines removed the bolts, 1 or 2 men knocked loose the angle bars, and 1 man removed the rail anchors. In addition, 1 man with a push car loaded with surplus tools and materials peddled tie plugs, 3 men with lining bars threw out the old rail, and 2 men with brake shoe keys hooked the old tie plates and threw them on the roadbed shoulder, outside of the new rail. One man with a claw bar pulled any spikes missed. Five to ten men with "hooked" shovels lowered or "eyed out" the ballast in the cribs under the rail so that it would not foul the adzing machine bits. The "hooked" shovels used were worn track shovels that had been cut away on each side so that they would fit between the ties, and bent into a sharp hook at their ends.

Other men in the head gang included 4 to 6 men who set tie plugs and 3 men with spuds who drove them down; 1 man with a broom, who swept the ties; 2 men with a punch and a sledge, who followed driving down any spike stubs; and 8 men with three adzing machines adzing the ties. Of these latter men, 1 was the mechanic in charge of the adzing machines and another was kept busy changing bits, leaving 2 men for the

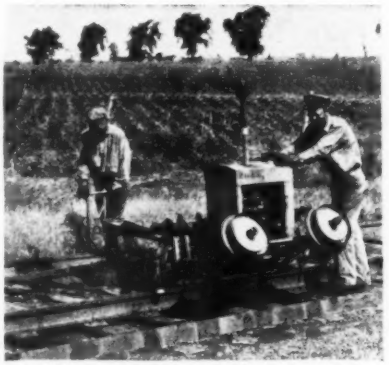
operation of each machine. The adzing machines were followed by 1 man with a broom sweeping the ties, and 2 men, one with a bucket and the other with a brush, applying hot creosote to the freshly adzed surfaces. Three men placing the new tie plates on the ties completed the head gang.

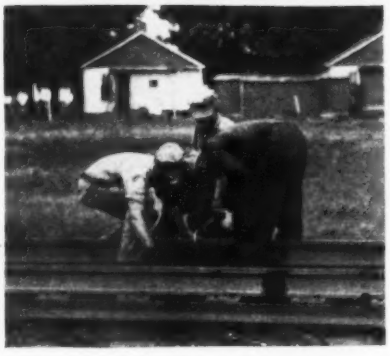
The rail crane crew, employing a Parsons rail crane, consisted of 1 tong man, 2 men at opposite ends of the rails to guide them in place, and the rail crane operator. The man handling the rear ends of the rails also placed steel expansion shims of the proper thickness.

The rear gang under the second assistant foreman consisted principally of the rear bolters, plate straighteners and gaging crews. In this gang three men applied bolts and spring washers on joint bars starting the bolts by hand. One of these men carried an angle bar clamp which consisted of a lever arm and hook, which was applied over the rail and angle bars at one of the center bolt holes. The weight of the man applying the clamp, downward on the lever arm, produced a horizontal force toward the rail on both angle bars. As the bars were thus applied, the clamp operator tapped their bases with a track chisel to insure their proper fit in a vertical position. Two men with a bolting machine tightened the bolts.

These operations were followed immediately by a head gaging crew consisting of 2 spikers, 1 man to nip up ties, and 1 man to line the rail. Next were 2 to 6 men with spike mauls straightening tie plates, one of whom also put on insulated joints, and then followed 5 to 7 regular gaging crews consisting of 3 men each, gaging at every third tie. Each regular gaging crew consisted of 2 spikers and 1 man with a bar for lining the rail or nipping ties. Two men followed the gaging crews, straightening any tie plates that were still out of line. Other men in the gang included 1 man with a push car carrying surplus tools and material, who spiked up crossings in full and filled them in; 1 man who distributed the rail anti-creepers; 2 men with picks, who knocked holes in the ballast under the rail where the anti-creepers were to be applied; and 2 men who applied the anticreepers.

In addition to the foregoing men in the head and rear gangs, the following men were assigned to the gang as a whole: 2 flagmen; 1 motor car man, who operated a motor car train and to whom was assigned the task of greasing all motorized equipment, except the rail crane; 1 drill man with a push car, carrying a Nuway motor-generator outfit and an electric saw and drill; 3 waterboys; 1 tool car man; and a bit grinder. The last mentioned two men remained with a tool car which was set out with the other outfit cars, and worked continuously at grinding bits and repairing other tools, principally spike mauls. The adzing machine men were supplied with enough sharpened bits each morning to last till noon, and were





Top Above—Three Adzing Machines Were Used. Center—Two Men With a Bucket and Brush Applied Hot Creosote to the Freshly Adzed Surfaces of the Ties. Bottom—Three Men Applied Joint Bars, Bolts and Spring Washers, Using a Specially Designed Clamp to Hold the Joint Bars

again supplied with enough bits at noon to last until quitting time. This eliminated the necessity for carrying bits or adzing heads back and forth between the adzing machines and the bit grinder periodically throughout the day. In addition to these men, a few men were frequently sent ahead to open up crossings in advance of the rail gang. Record was made of the heat numbers of all new rails as laid.

As indicated in the operations already described, the new rail was spiked only at every third or fourth tie during that part of the day that the actual setting in of the rail advanced, full-spiking being done during the last hour and a half, or so, of the working period of the day by the entire gang, with the exception of the rail crane crew. In this finishing-up work, the rear end gang dropped back to the beginning of the day's work and worked forward, while the head end gang worked backward from the point of closure.

Throughout the day, trains were permitted over the partially spiked track under slow order, closures being made whenever necessary to this end. The assistant roadmaster kept in close touch with the movement of trains and when they could be expected, and advised the assistant foreman in charge of the head gang when to make closure to avoid train delay. The closure at the end of each day was made with a 112-lb. to 90-lb. compromise joint carried on the rail crane. The old rail was cut quickly by notching the base on each side with a chisel and then bending it sidewise with the rail crane. When stressed in this manner, one blow on the chisel generally served to cut the rail at the desired point. To compensate for the difference in the height of the rails and to provide a suitable run-off, the 90-lb. rail was shimmed up for eight or ten ties back of the offset joint.

Organization Varied

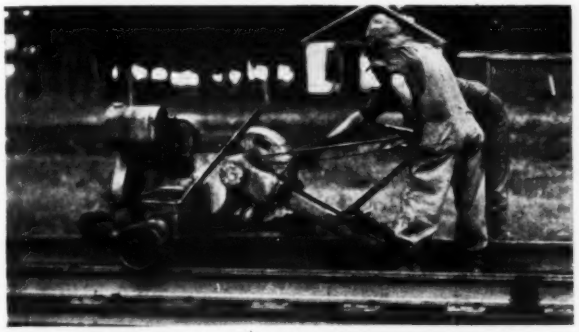
As mentioned in the detailed analysis of the gang operations, the number of men engaged in some of the operations varied. This was done, as necessary, to keep the gang spread out and all operations moving along at the same rate. If, for example, the rail crane started to crowd the head gang, more spike pullers were added. If the gagers began to get too far behind, more gaging crews were added, or, on the other hand, if the gagers crowded the rail crane, a few of them dropped behind temporarily and began spiking up in full. Ordinarily, as already stated, every third tie was gaged. However, when working through yards or station grounds where an unusual number of delays were encountered at switches or for other reasons, the gaging crews were cut down and gaged only every fourth tie, and a number of the men from these crews, along with the drill man, were added to the rail crane crew to form a switch gang.

The rail crane stopped at a switch only long enough to lay the frog, the

main line lead rails, the switch point and the stock rail. As soon as these were spiked sufficiently to allow the crane to proceed, it moved ahead with the regular relay work, leaving the switch gang to make the switch safe for train movements on the main track. When this had been done, the switch point was spiked for main line traffic. Toward the end of the day, following final closure of the rail, the crane crew and the switch gang dropped back and completed the switch installation, including in each case the connection with the siding behind the frog. As mentioned previously, pre-cut and drilled closure rails for the leads were furnished from the system rail yard for all switches, making a considerable saving both in time and of short length rails.

When a train was expected and closure was made, the rail crane was set off the track or was returned to the nearest switch to clear the main line. All other equipment was removed from the track. While awaiting the train, nearly the entire gang was kept busy spiking, gaging, applying rail anchors, etc., and immediately following its passage, the regular operations were resumed. Thus, by these methods of varying the gang organization, all the men were kept productively employed the entire working day. If there were no switches to complete when the final closure of the day was made, the rail crane crew went back to headquarters, where the crane was utilized to transfer or load material, or the crew employed in oiling and taking care of the rail crane itself to keep it in first class operating condition.

Varying the gang organization to meet conditions was made possible to some extent because many of the men were skilled in all of the various rail laying operations. Of the 125 men in the gang, approximately 75 had had three or more years experience in rail laying or section work, many of them having served with this particular gang for several years. Only 20 to 30 men had had little or no section or extra gang experience and these men were used on those operations requiring the least skill or knowledge of the various rail laying operations.



The Rear Bolting Machine in Action —Two Other Such Machines Were Used in Stripping Operations

The Head Gaging Crew of Four Men Was Followed by Three Men Who Straightened Any Skewed Plates

Following the Gaging, Two Men Equipped with Special Tools Applied the Rail Anti-Creepers

Quality of Work Good

Although, as previously mentioned, this gang laid an average of nearly 20,000 ft. of rail a day, and at one time made a record run of 25,008 ft., the quality of the relay work was good. The practice of gaging every third tie resulted in perfect gage throughout and almost complete absence of short line kinks. This condition obtained even after considerable traffic had passed over the new rail and could be attributed to several factors, one of which was the care used in spiking the line rail to good line, and the gage rail to exact gage. Another factor was the careful attention that was given the straightening of the double-shoulder tie plates beneath the rail to avoid its having bearing on one of the plate shoulders with the possibility of becoming surface bent, kinked, twisted or base damaged. Both the good line and gage were due also to some extent to the use of a slow order on the track until the tie plates were properly seated on the ties.

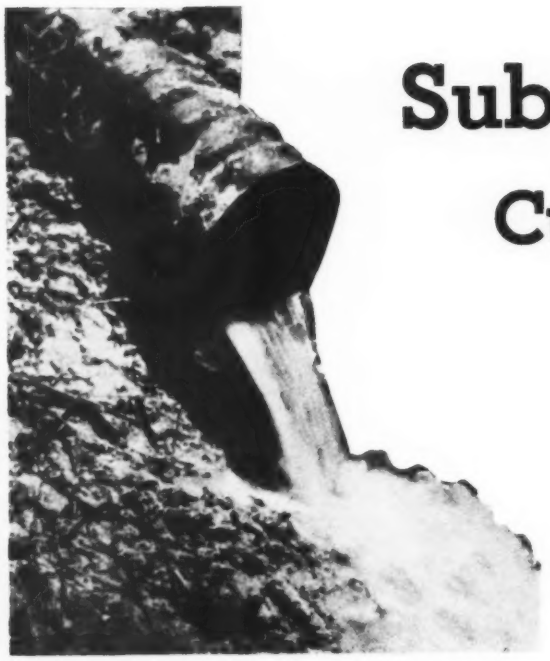
Possibly the most important factor in the quality of the work produced in the rail laying described was the experienced workmanship employed. While the gang was keyed up to lay rail at a fast pace, there was no excessive haste. The men worked swiftly but surely, without lost motion, as only experienced men can. All spikes were driven straight, without overdriving. The same quality of workmanship was employed in all other operations—the joint bars were placed vertically and with uniform bolt tension; rail expansion was properly distributed; rail anchors were placed properly snug against the ties; and switches, when finally completed, were standard to the last detail.

The rail gang employed on the Short Line work was housed in a group of outfit cars, which were spurred out as close to the operations as possible.

Follow-Up Operations

Within a week after the completion of the relay work, the rail and other released materials were loaded with a work train and crane by the same gang which unloaded the new rail. Following the relaying of the rail, an

(Continued on page 322)



Subdrainage Cures the Sliding of High Fill

Permits Illinois Central to abandon 466 ft. of timber trestle as embankment becomes stable

Some of the Drains Discharged Up to 100 Gal. per Min. for 48 Hours After Pockets Were Tapped

BY jacking a series of 31 lateral drainpipes into a high fill which had been the scene of repeated slides because of the inclusion of water pockets in it, the Illinois Central recently dried up this fill and is now in a position to abandon 466 ft. of timber trestle which had been driven through the fill to carry traffic, and which is nearing the end of its service life. The drainage system installed not only appears to have overcome the sliding condition permanently, but was completed at a cost less than that which would have been involved in renewing the trestle.

50-Ft. Fill

The unstable fill involved in this work, which is approximately 50 ft. high and extends over a distance of about 1,000 ft., is in the north approach to the road's crossing of the Bayou de Chien drainage canal, about eight miles north of Fulton, Ky., on its single-track Edgewood cut-off between Edgewood, Ill., and Fulton. Ever since the construction of this fill in 1925, which consists largely of clay secured from cuts immediately to the north, it has given serious trouble. When dry, the clay involved is firm and stable, and before it was taken from the cut for the embankment construction it showed little evidence of its susceptibility to sliding. However, when wet, the material loses practically all of its supporting power. Sliding of the fill actually started before it was completed, and until the time the line was put in operation large quantities of material were wasted over its slopes in the hope that in time they would reach a state of equilibrium.

In spite of this excess material, it was impossible to stabilize the fill, and after operation was started over the line it was necessary to continue wasting earth and cinders over the slopes to replace the material which continued to move downward and outward, sometimes gradually and sometimes suddenly. In fact, during the latter part of 1928, a slide occurred which made it necessary to construct 219 ft. of untreated, open-deck pile trestle in the fill to restore traffic. In 1931, as the result of further slides, the trestle was extended 163 ft., and in 1934, it was again extended a distance of 84 ft. While this 466 ft. of trestle offset the sliding of the fill in this area, its maintenance was expensive. Therefore, when the early replacement of the trestle appeared necessary in 1939, consideration was given to stabilizing the fill through subdrainage and eliminating the trestle.

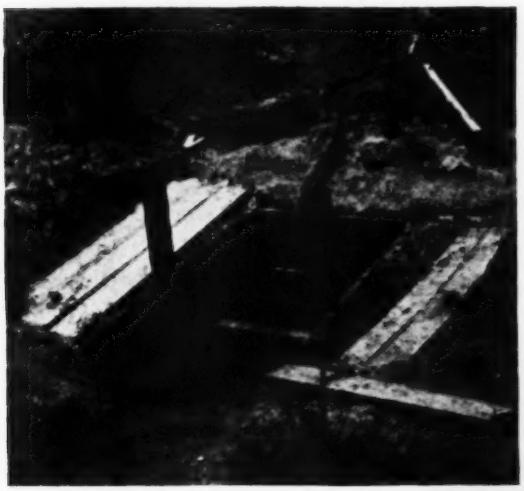
Large Pockets Found

With this in mind, the road, using its regular section forces under the supervision of an experienced engineer, undertook a sub-surface investigation of the fill to determine the location of any water that might be in it and to learn if the removal of any water found would give reasonable assurance of overcoming the trouble. This investigation, which was made largely by test borings with a special 2-in. auger, revealed that the fill contained a large number of cinder and gravel pockets that were holding large quantities of water, and that it was these that were keeping the entire lower part of the fill saturated and ready to slide at the slightest provocation.

The low points of these pockets, with few exceptions, did not lie directly beneath the track, but rather to both sides of its center line at distances out ranging from 27 ft. to as much as 80 ft. This, and the character of the material in the pockets, were not surprising in view of the fact that as the slopes had slid downward and outward repeatedly, the fill topping of cinders and ballast had moved downward to replace the original material in the fill. Confined by the relatively impervious clay, the cinder and gravel pockets formed large reservoirs for water which constantly leached into and kept the lower part of the fill saturated. As a matter of fact, the lower slopes of the fill were so saturated and spongy at places that they would not support a man, and at one time a team of mules mired down and had to be pulled out. In view of the conditions found, all pointing to the confined water as the cause of the trouble, it was evident that the embankment could not be stabilized unless freed of this water. Therefore, prelim-

inary plans for a suitable drainage system were prepared, and when estimates indicated that such a system could be installed at considerable less expense than that which would be involved in replacing the 466 ft. of trestle, it was decided to make the installation.

Having arrived at this decision, a second investigation of water conditions in the fill was carried out, more detailed and thorough than the preliminary investigation, which resulted in the development of a highly effective pipe drainage system. This system involves essentially parallel lateral drains, from 58 ft. to 207 ft. long, extending into the fill from both sides to the low points of the water pockets, but in no case more than 50 ft. apart. In addition, it includes an open ditch parallel with and about 350 ft. east of the center line of the track to carry away the water collected by the drainage system in the east side of the fill. All of the laterals in the system are of 8-in. USS pure iron corrugated pipe, perforated and asphalt-coated, and are terminated at their upper ends in risers of the same character and size of pipe, these risers, in each case, extending upward to the normal slope level of the fill.



Left—The Riser Pits, Each of Which Tapped a Water Pocket, Were From 9 to 22 Ft. Deep. Below—A Set-Up of the 100-Ton Hydraulic Jack as It Was Employed to Place All of the Pipes

Jacking Method Employed

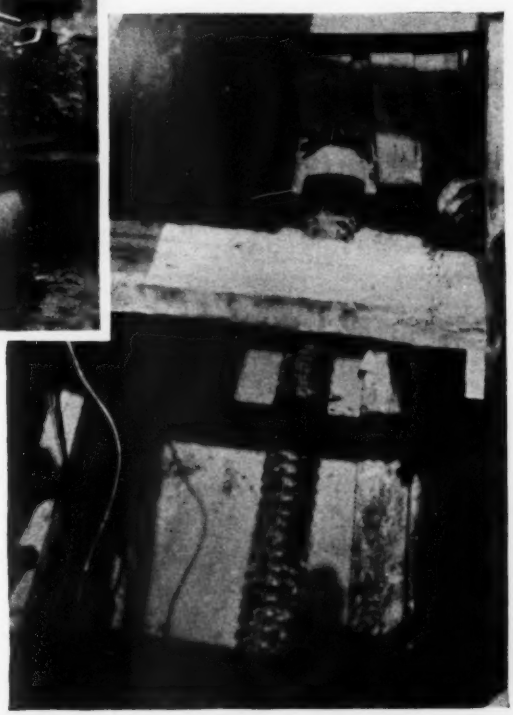
All of the lateral drains were installed by the jacking method, while all of the riser pipes were installed in pits excavated for the purpose. The method of installing each lateral drain involved first the excavation of the riser pit down into the water pocket to be drained, and then the excavation of a jacking pit in line with each proposed lateral drain, usually near the mid-point of its length, from which the pipe could be jacked in both directions. Digging both of these types of pits provided a check on the previous test hole borings and permitted the determination of the bottom locations and grades of the laterals with great accuracy. The riser pits were made 4 ft. by 6 ft. in section, while the jacking pits were made 20 ft. long, in line with the laterals, and 8 ft. wide. In both cases excavation was by means of hand shovels, and such sheeting as was required consisted of successive rings of 3-in. by 8-in. timber, which were put in position, one beneath the other, as the excavation advanced.

Completing the excavation in the jacking pits, which was invariably in water, required that the pits be pumped out continuously. In fact, it was usually necessary that the pumping be continued for at least 48 hours following completion of the excavation before conditions were suitable to permit jacking operations. All of this unwatering work was done with 3-in., gasoline-engine-operated centrifugal pumps.

In the case of each lateral, the downhill section was jacked through first, opening up a waterway for the large volume of water to be tapped subsequently deeper in the fill. Then the jacking equipment was reversed in the pit and the uphill section of the lateral was jacked through to the low point of the pocket to be tapped, directly at the bottom of the riser pit involved. As this latter jacking progressed, flow within the pipe invariably increased. In several cases this reached as much as 100 gal. per min. and continued for as long as three days with no appreciable diminution, after which it slowed down to a trickle, or stopped altogether, when the particular water pocket tapped had become completely drained.

Use 100-Ton Jack

The jacking equipment employed included essentially a 100-ton hydraulic jack, a 6-in. steel pipe pushing sleeve, in 10-ft. sections, and a pusher head at the advance end of the pusher sleeve which displaced the fill material laterally, as it was



Right—Looking Into One of the Jacking Pits, Showing a Section of Pipe Ready to Be Jacked Forward Into the Fill

moved forward, to a diameter approximately one inch greater than the outside diameter of the corrugated pipe to be installed. As each section of the sleeve was jacked forward it carried with it a 10-ft. length of the corrugated pipe which had been slipped over it. Through this

The Top of One of the Riser Pipes, Showing the Rock Backfill Around it and the Iron Grate Provided in the End

method of installation, the pipe as placed was free of fill material and when the jacking was completed there remained only to back out the jacking sleeve.

As soon as water conditions in a riser pit permitted, such further excavation as was necessary was completed, and then the riser pipe was installed, with a 90-deg. elbow connection with the lateral pipe. Subsequently, each riser pit was backfilled with crushed rock or other porous material, producing in each case a large catch basin within the fill for the full height of the riser pipe. In a similar manner, each jacking pit was backfilled with porous material over its entire area to a height of one foot above the top of the pipe. Above this level each pit was backfilled with the material removed in excavation, except for a column 4 ft. long and the width of the pit in section, which was filled with porous material to the top of the slope level. Thus, at the sites of the jacking pits, as well as at the locations of the riser pits, large catch basins were afforded for drawing water out of the fill.

To supplement the effectiveness of the subdrains themselves, the material excavated from the riser pits, and the excess excavation from the jacking pits, was spread over the fill in such manner that water falling on the slopes will be directed to the pits and thence carried off through the subdrainage system. At the same time, the upper part of the fill was dug down several feet to be certain that there were no untapped water pockets directly beneath the track. Then the entire embankment was brought up to a theoretical slope of 1½:1 with cinders. In four cases, where it appeared that small water pockets existed directly beneath the track, laterals were installed near the top of the fill, in each case draining to the west side.

Fill Completely Stabilized

Altogether, approximately 4,000 ft. of subdrainage pipe was installed in the fill in the 31 main laterals and their risers, and the four relatively shorter laterals directly beneath the track. Carrying out the pit excavation simultaneously at several points to speed up operations permitted the entire drainage system to be installed in approximately 60 days. Since the completion of the work, flow from the fill has stopped entirely, except after heavy rains, and the slopes appear to have become completely stabilized. The old trestle has not been removed to the present time, but no more maintenance work is to be done on it, and it is to be taken out when its condition appears to make that desirable.

The final investigation and the complete installation of subdrainage in the fill were carried out by Young & Greenawalt, contracting engineers, Chicago. The work was done under the general direction of F. L. Thompson, vice-president and chief engineer of the Illinois Central, and under the supervision of C. I. Van Arsdalen, division engineer of the St. Louis division.

At the Bottom of One of the Drain Riser Pits, Showing the Joint Between One of the Laterals and Its Riser Pipe

Rail Gang Relays 2 Miles a Day

(Continued from page 319)

enlarged section gang of 12 to 15 men tamped up any swinging ties and drove down the spikes as occasioned by the settling of the tie plates on the ties. This gang also corrected any other conditions necessary, including

Drilling a Rail With an Electric Drill Powered by a Generator Outfit Mounted on a Push Car

any imperfections in line and gage that might have become apparent. All bolts were retightened by hand approximately 30 days after the rail relay and, several months later, a bolting machine was operated over the track to retighten all bolts. The section gang was followed shortly by a reballasting gang of approximately 40 men.

The improved standards for rail relay work on the Rock Island described in this article, as well as the extra-gang organization employed, were developed under the direction of W. H. Hillis, at the time engineer maintenance of way, and now assistant chief operating officer of the Rock Island. The relay work on the Short Line, as described, was done under the supervision of W. E. Heimerdinger, district maintenance engineer, Des Moines, Iowa; T. W. Brown, roadmaster, Des Moines; John Burns, assistant roadmaster in charge of the extra gang, who is now roadmaster at St. Joseph Mo.; and Francis Charles, extra gang foreman.

Should Substitute Slide-Rule for Thumb-Rule in Bridge Maintenance

Stress Computations for Bridge Maintenance

By ROY N. BRODIE

Chief Draftsman, Boston & Maine, Boston, Mass.

IN these days of acute economic stringency, the importance of planning repairs and renewals of structures on a scientific basis cannot be over-estimated. The problem of maintaining structures on the majority of railroads has become one of securing the most for the least immediate expenditure, rather than one of long-range economy. However undesirable this situation may be, it is here and must be faced. Under these conditions, it is obvious that any device or method that will permit postponing replacements, within the bounds of reasonable safety, will justify itself economically.

Technical Men Can Help

To accomplish this end, something is needed to show not only when to do the work, but when not to do it. This can be accomplished in large part by relatively frequent computation of the stresses in the structures in question, based upon detailed examinations and reports of the extent of their depreciation, and in this work the knowledge and ability of the technically trained men in the structural design departments of the railways could be enlisted to large advantage. What follows applies particularly to timber bridges, and to steel to a lesser degree, since metal structures are maintained on the basis of computed strength to a much greater extent.

The practice of making renewals on the recommendations of foremen and inspectors, who frequently base their recommendations entirely on scrutiny and judgment, is still prevalent, but steadily rising costs are making this procedure unprofitable. For many years men have relied upon their ability to tell a good stick from a poor one, or to distinguish between mere rust and serious corrosion, and their success is attested by the small number of accidents that have occurred as the result of structural failures. There is, however, no assurance that they have not made a lot of unnecessary replacements in pursuit of a conservative margin of safety determined by judgment. It is no adverse reflection on their work to point this out and to say that the time has arrived to substitute slide-rule for thumb-rule in maintenance. It is realized, of course, that many needed replacements occur in parts of structures not susceptible to computation, and these will continue to be decided upon by whatever policy prevails.

It is not intended that the entire responsibility for deciding that renewals can no longer be postponed, especially if of timber, should be transferred to the office of structural design. The recommendations made, or information furnished as to current capacity or remaining margin for safe operation will, nevertheless, be of great assistance and form a reliable guide in estimating requirements. If it be contended that there is no substitute for good judgment, the writer heartily concurs; it is bad judgment that the suggested procedure aims at reducing.

Method of Procedure

In many organizations the personnel and equipment at hand are capable of furnishing the information for office computations, without expansion and with little added expense. If they are not already doing this, the inspection forces should be trained to render systematic and uniform reports, based upon physical investigation of designated parts of the structure. Experience in this procedure has indicated that it is no more difficult to make a thorough than a cursory examination, once the routine has become thoroughly established.

If the additional time and facilities needed for detailed investigation require the enlargement of forces, this expense will, more than likely, be offset by the resulting savings in postponed renewals. There is also the advantage of definite knowledge of the margin of safety under which structures are being operated. Local conditions, the special behavior of some kinds of material, and climatic considerations may affect the advisable frequency of making inspections, but under average circumstances annual inspections will generally suffice for checking figures. Thoroughness, rather than frequency, of inspection, is generally of more value to those reviewing the stresses.

The inspection personnel should not be expected to decide which parts of a structure are vital to its performance, nor to try to guess the requirements of the office computer. The points at which sections are to be calipered, or timber is to be bored, should be indicated definitely in its instructions. Inspection notes alone are seldom sufficient for proper calculations, and the making of illustrative sketches should be required and encouraged.

Granting that many inherent uncertainties prevent exact knowledge of the condition of a structure, it will be found that standardized inspection methods will tend to reduce the inevitable errors to a more or less constant ratio. Comparison of successive reports will indicate the rate of deterioration and expose any inconsistencies. To obtain maximum benefit from the detailed reports, therefore, office treatment should be prompt and uniform, and a regular routine should be adopted for handling. Maximum permissible stresses, and the stresses on which capacity is to be based, must be decided upon and adhered to. Methods of computation and of evalu-

ating sections reduced by decay or corrosion should be definitely established so that all calculations will be on a comparable basis.

The most suitable and convenient office in which to make the computations will be decided largely by the size of the organization and the points where inspection reports are customarily received. On most roads this will be the office of the engineer of bridges or structures, where the necessary structural designers are usually stationed. The employment of structural draftsmen on these maintenance computations will also help to solve the problem of retaining a workable designing force during periods of slackness in construction. In fact, it is probable that under current conditions more real economic benefit will be derived from employing designers on maintenance work than on new construction, which today is largely reduced to standard practice. The opportunities for practicing studied economy are nowhere greater than in the making of repair plans.

The draftsmen engaged in this work should be given ample facilities for studying conditions in the field, both individually and in company with the regular inspectors, and a regular system of notifying those responsible for maintenance as soon as the computed findings are available will enable them to make full use of the information in planning renewals. Where this system has been newly adopted or extended in scope, it will be found, I am sure, that the maintenance personnel will soon acquire the habit of referring doubtful cases to the office.

The writer has experienced many instances of repairs being postponed after issuing information on computed capacity — repairs that otherwise would have been made where reliance was placed on inspection and judgment alone. The subsequent behavior of such structures in no instance has failed to justify the postponement. On the other hand, cases could be cited where the detailed inspections required for computations have disclosed serious conditions, which ordinarily might have escaped attention.

This method of inspection could also be used to large advantage in determining the condition of trestles or other structures on the service tracks of shippers, the maintenance expense of which is usually borne by the shippers, providing a means of preventing serious differences of opinion between railway representatives and the owners of the facilities with regard to the necessity for repairs. If the shippers can be assured that maintenance requirements are determined by a definite system of figuring, and not based merely upon the personal opinions of inspectors and supervisors, much of the ill-will now frequently created in them when confronted with demands for the repair or strengthening of their structures will be prevented, to the definite advantage of the railroad company.

The writer believes that the adoption or extension of the procedure described will tend (1) to prevent unnecessary repairs; (2) to prevent the omission of necessary repairs; and (3) to insure the distribution of repairs and strengthening to points where greatest benefit will be derived.

Plywood Tops for Cabinets and Counters

THAT Douglas fir plywood can be used effectively for counter tops, filing cabinet tops and other working surfaces was demonstrated recently when the Denver & Rio Grande Western made extensive use of this material for these purposes while modernizing and redecorating its general offices at Denver, Colo. The plywood tops which it installed at that time have proved not only entirely practical from the standpoint of providing a perfectly smooth working surface, but, covered with linoleum cemented in place, the finished installations harmonize with and add to the general appearance of the office areas.

More than 500 Lin. Ft. of Cabinets, Counters and Cupboards Were Covered With Plywood

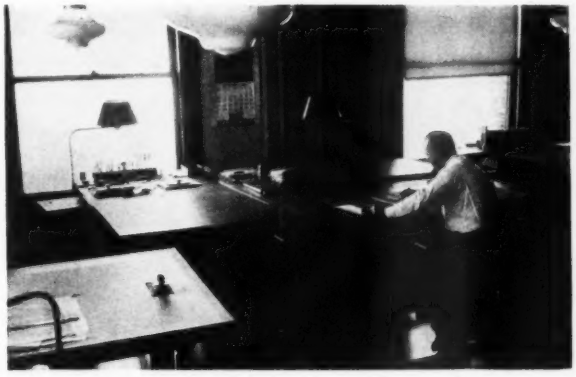
In the case of metal filing cabinets, which, as is the usual case, were arranged side by side in long banks along aisles or side walls, the purpose of covering them with plywood was to afford a continuous smooth working surface on top, without cracks between the individual cabinets, while at the same time giving them a more substantial, built-in aspect. The surfacing of counters in general office areas was, likewise, to improve appearance and to afford the best working conditions. In the drafting room, extensive assemblies of map filing drawer cabinets and cupboards were covered with plywood and then surfaced with linoleum. These cabinets and cupboards, at drafting table height, and arranged in banks, give the room a neat appearance and provide an abundance of working space for the examination and handling of maps and records. In emergencies they are also used for drafting surfaces.

Throughout the general office areas, the linoleum tops are in dark green, whereas, in the drafting room area the linoleum topping is of a light tan shade to match the drafting table tops, which were also covered with linoleum. The practicability of the linoleum surface for drafting tables has come about through the practice now prevalent of securing drafting paper and tracing cloth to the tables by means of rubber cement tape, rather than thumbtacks, which in no way injures the surface, and the light tan color linoleum has been found perferable to the darker shades from the standpoint of the drafting work itself.

In the case of all of the plywood tops for cabinets, counters and cupboards, ¾-in. 7-ply plywood was used, cut to size and edged with

birch molding strips made by the carpenter forces of the road. The molding strips, with a plain rounded outside face, have a maximum thickness of about ¼ in., and are about 1½ in. wide, this width being sufficient to house the linoleum on top, producing a continuous smooth surface over the edge, and to lap the top edges of the facility covered sufficiently along the bottom to hold the plywood top securely in position. The moldings, which were given an oak stain finish, were both glued and nailed with finishing nails to the edges of the plywood, insuring a tight and secure fit. The linoleum covering, which is of a type and weight especially designed for counter tops not subject to foot traffic, was cemented to the plywood surface, no rails being used.

Altogether, approximately 500 lin. ft. of plywood tops for cabinets, counters and cupboards were installed in the executive, traffic, accounting and engineering department offices, involving the use of approximately 1200 sq. ft. of plywood. The work involved was carried out under the direction of C. M. Lightburn, valuation engineer of the road, who was in direct charge of the office renovation work. The installation of all of the tops was done by company carpenter forces.



Many of the Cabinets and Cupboards in the Drafting Room Were Covered Effectively With Plywood and Linoleum

What Our Readers Think

Manufacturers Need More Co-operation

Chicago, Ill.

TO THE EDITOR:

It was with much interest that I read the editorial in your March issue entitled Off-Track Equipment — A Challenge to Manufacturers.

What do the railways want in the line of off-track equipment? I believe that every worth while manufacturer of equipment is more than willing to build equipment suitable for off-track railroad work. While we are not manufacturers of equipment, we do represent builders of crawler-type tractors and allied machinery. We have contacted the railways for several years and have found engineering and maintenance of way officers much interested in what we believe can be done with off-track equipment. However, in practically every case, we have been stymied by higher-ups.

We have approached the railways with an educational program concerning the advantages of modern equipment and methods of doing work, both in their interest and that of ourselves. Time after time we have offered to make demonstrations on their rights-of-way without any cost to them whatever. Through such demonstrations, we have felt that we could show conclusively the comparative costs of proposed methods with those now in use, and, at the same time, could find out whether we have the right kind of equipment, or the type of changes which should be made in it to make it most satisfactory.

We are not attempting to say that we or others now have the answer for the railways' needs for off-track equipment, but we do say that until such time as the railways give us permission to demonstrate what we have, they cannot expect us to develop equipment best suited to their requirements. There have already been many successful applications of off-track equipment in railway work, including those for the mowing of the right-of-way and for ditching and bank sloping, and we are convinced that there are many more such operations that could be carried out more effectively and economically with off-track equipment than by present methods. Under these circumstances, it appears that your editorial might well have been headed—"Off-Track Equipment—A Challenge to the Railroads."

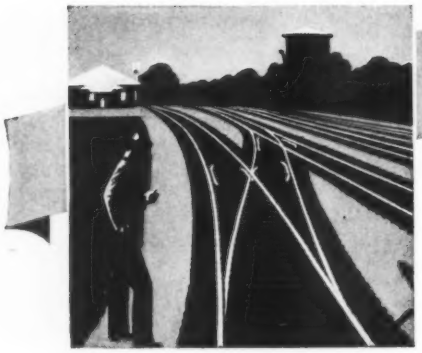
B. C. PATTEN,
Patten Tractor & Equipment Company.

New Books

Bridge and Building Proceedings

PROCEEDINGS of the American Railway Bridge and Building Association, forty-sixth annual convention. 231 pages, illustrated, 6 in. by 9 in., bound in cloth. Published by the Association, 319 North Waller avenue, Chicago. Price $2.

Reflecting the purpose and character of the association, this volume, which contains the proceedings of its forty-sixth annual convention, held in Chicago on October 17-19, 1939, contains a wide range of valuable practical information for those confronted with the problems involved in the maintenance of railway bridges, buildings and water service facilities. The feature of the volume, which is similar in style and makeup to preceding annual volumes of the Proceedings of the association, is the reprinted reports presented before the convention, which have to do with the use of preframed treated timber for replacement purposes; bridge painting problems resulting from deferred maintenance; the maintenance of shop and enginehouse roofs; methods of safeguarding bridge structures; glazing maintenance in shops and enginehouses; deteriorated concrete—causes, detection and repair; the elimination of slow orders; and pumping equipment to meet today's requirements. Other features of the Proceedings are papers on The Strengthening of Old Bridges, by G. A. Haggander, assistant chief engineer, Chicago, Burlington & Quincy, and on Meeting Today's Requirements in Railway Structures, by A. T. Hawk, engineer architect, Chicago, Rock Island & Pacific; and an address by Samuel O. Dunn, editor, *Railway Age*, dealing with the broader aspects of the railway problem in the United States. Other sections of the volume are given over to a report of the business session of the convention.



WHAT'S the Answer?

How to Measure Tie Spacing

When spacing ties, should the distance be measured from center to center of the ties, or between the faces of adjacent ties? Why?

Rail Needs Even Support

By F. G. Campbell
Assistant Chief Engineer, Elgin, Joliet & Eastern, Joliet, Ill.

Theoretically, the unsupported portion of the rail should be uniform between ties, but, obviously, it is impossible to attain this ideal in practice to a minute degree of accuracy. The closest approach is made, however, when ties are spaced by measuring from center to center. There are several reasons why this is so. It is now the accepted practice to break or stagger rail joints which, in most cases are of the suspended type, requiring two ties at each joint, the spacing between which is determined by the joint design. After the joint ties have been spaced, the intervening half panel of the rail must be filled in with a predetermined number of ties, spaced accurately to give a uniform number to each rail length.

If the intermediate ties are spaced center to center, there will be slight variations in the face-to-face spacing because of variations in tie widths. If these intermediate ties were to be spaced by a predetermined face-to-face spacing the result would be an unequal accumulation of the variables in width and, therefore, unequal spacing between the last intermediate tie and the joint tie next adjacent to it. In other words, the closing space in the panel would be too small or too wide, depending on whether the ties were over or under size. The only way to avoid this unequal closure spacing would be to measure the width of each tie accurately and then determine an independent face-to-face spacing for each half panel, a procedure that would be entirely impracticable.

With the present predominance of sawed ties and the improved manufacture of hewed ties, there are actually, assuming that the ties are selected carefully, no important variations in the spacing between ties as a result of spacing the ties by center-to-center measurements. The A. R. E. A. specifications, for crossties permits a total variation of only an inch in the width for any specified size; actually, this variation is usually much less. Furthermore, where tie plates are used, they, rather than the tie, provide the direct support for the rail. The A.R.E.A. specifications permits a tolerance of only ⅛ in. in tie-plate widths, so that if the ties are spaced center to center, and the tie plates are centered on the ties, the results will be practical uniformity of the unsupported portion of the rail.

Center to Center

By Armstrong Chinn
Chief Engineer, Alton, Chicago

When spacing ties, the distance should be measured from center to center of the ties; in fact, there is no other way to measure it if proper tie spacing is to be maintained. Practically all railways have established standards for spacing ties by fixing the number of ties to the rail length for each class of track. The only way a fixed number of ties can be spaced under a rail of given length is to measure and mark the spacing on the rail and then center the ties to correspond with the marks.

Send your answers to any of the questions to the What's the Answer Editor. He will welcome also any questions you wish to have discussed.

To Be Answered In July Issue

1. Is there any special advantage in the use of long ties at soft spots and across swamps? If not, why? If so, what length?

2. Is there any advantage in using water for puddling when back filling around foundations? Over pipe lines? Any disadvantage? Why? How much water should be used?

3. What precautions should be observed when loading tools to be carried on motor cars or tractors? Is any special provision for carrying them desirable? Why?

4. How far above the ground-water level is it safe to cut off untreated piles? Treated piles? How is this determined?

5. Where track is being raised from 1½ to 3 in. out of face, is it better to use a single tie-tamping outfit or a battery of two or more? Why? What sized (number of tools) outfit or outfits should be used? How many men should be in the gang?

6. Should the frost box of a water tank be left open or closed during the summer? Of a water column? Why?

7. Where weeds are destroyed by chemical applications, at what period of growth should the application be made? Why? Is more than one application necessary?

8. What size of air compressor is most suitable for a building gang? For a bridge gang? What tools should be operated from such a compressor?

Ties are not always all of the same width, and, obviously, if they are spaced face to face, the spacing will need to be changed every time a tie is renewed with one of different width. A change in the spacing in one rail panel will carry over into the next one and from that to the next one adjacent to it, and so on, creating endless work and confusion. Most roads use several sizes of ties in each class of track. For instance, sizes 4 and 5 are generally used in main tracks. Size-5 ties are 1 in. wider than size-4 ties, from which it is seen readily that if the ties are spaced face to face, the spacing will be disturbed every time a size-4 tie is replaced with a size-5 tie, and vice versa. To get away from these difficulties and maintain the prescribed standards for tie spacing, the distance between the ties must be measured from center to center.

Need Space for Tamping

By A. B. Chaney
District Engineer, Missouri Pacific, Little Rock, Ark.

When spacing ties of varying width, it is better to measure the distance between the faces of adjacent ties than from center to center, to equalize more nearly the rail support; to provide sufficient space for tamping; and also as a matter of economy. Obviously, eight ties 9 in. wide will provide the same support for the rail as nine ties 8 in. wide. The surface of the track is maintained more easily where the rails are given uniform support.

New Conditions Arise

By Retired Roadmaster

When I started to work on the section there was a complete lack of uniformity in the dimensions of the ties with which we were supplied, the cross section ranging from, say 9 in. by 12 in. to that of an oversized fence post. At that time joints were not staggered and it was customary to select the largest ties as joint ties. The very small ties were sorted out and used in unimportant sidings. After the ties were culled in this manner there was still considerable variation in width and, while we were supposed to use a standard number of ties to a rail length, it became the common practice to space the ties by inserting the blade of a No. 2 track shovel between them. As the blade of the shovel was approximately 10 in. wide, this insured ample room for tamping.

As time went on new conditions arose; joints were staggered, ties became somewhat more uniform in size; and tie plates came into common use. Today, ties that are purchased in accordance with the A.R.E.A. specifications vary so little in dimensions that there is no reason why the spacing should not be made to center-to-center measurements.

Defects in Masonry Structures

What defects are most commonly encountered in the under-water portion of masonry structures?

Cause Great Concern

By L. G. Byrd
Supervisor of Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

Old masonry structures have long been the cause of grave concern on the part of maintenance officers responsible for their condition. Most of those built of stone were constructed many years ago at a time when Portland cement mortar was not used. The mortar was, therefore, of lime or natural cement and in not a few cases has almost disappeared. Joints and cracks were filled with small spalls, and in not a few cases, especially where the current is swift, the small material has worked out, causing the larger stones to become loose and, in some cases, to work out. It was also the usual practice to support the masonry on a timber grillage, and in not a few instances scouring has at some time caused movement or settlement of the grillage, thus weakening the entire structure. When any of these conditions are noted, it becomes necessary to construct a coffer dam and reinforce or underpin the footing.

Many Causes

By A. R. Ketterson
Engineer of Bridges, Canadian Pacific, Montreal, Que.

This discussion applies solely to stone masonry; it does not refer to defects resulting from scour, since any substructure, not otherwise defective, may be damaged by scour. Since the defects are likely to depend on the period in which the structure was built, as well as upon the nature of the design, the character of the workmanship and upon local conditions, I will cite certain specific instances of defects that have developed.

At one time it was common practice to found masonry piers on a platform consisting of two or three layers of square-sawed timbers, which were or were not supported on piles. When units of this period are subjected to present day live loads and speeds, they sometimes settle by reason of the crushing of the grillage timbers or of the settlement of the piles. Sometimes the settlement of such a unit is reasonably uniform, but, unfortunately, oftener than not, it is accompanied by a decided tilt. Another defect sometimes found in old masonry structures, which may have a somewhat similar effect, is a deficiency in the bearing area because the footings were not given sufficient spread.

In some old masonry piers, the ashlar shaft is founded on a random rubble base bedded in mortar. Even when the upper (ashlar) portion appears to be in reasonably good condition, and where the pier has probably been carrying a nominal increase in the live load for some time, movement may develop because disintegration of the mortar in the base has permitted displacement of the irregular footing stones.

Another defect in most masonry piers below the water line is that of open joints, caused by disintegration of the mortar. These openings usually develop in the upstream end but often occur at various courses all around the unit. These openings between and in the courses, especially in old masonry piers that have only an ashlar facing with an interior consisting of spalls, which sometimes appear to have been thrown in loosely or with little mortar to bond them, permit disintegration to proceed in the interior, with the result that, if the condition is allowed to continue, a stage will be reached where there is a general loosening of the masonry throughout the structure, and movement may be observed in individual stones during the passage of live loads.

Sometimes cracks develop through these facing stones. If the condition is corrected in the early stages before movement of the individual stones begins, repointing of the masonry above the water line, and a thorough calking below that line, using lead wool or hardwood wedges, depending on the width of the opening, has been known to be effective over a long period. If, however, the condition has progressed to the stage where such measures do not meet the

requirements of the situation, grouting the interior may be effective. Otherwise, it may become necessary to encase the unit with a concrete jacket.

Still another defect which, although not located below the water line, may affect the underwater portion if the latter is not in good condition, is the development of open joints in coping stones. Water which finds its way through the heart of the pier, especially in northern climates, is a cause of rapid disintegration of the mortar in the interior.

In many cases the coping stones under the bearings of the superstructure are too small to distribute the live load directly over a reasonable area of the masonry immediately underneath. This sometimes results in a line of open vertical joints close to the bearing, extending down through the underwater portion, to aggravate the condition there, especially if open joints are also present below the water line. If the trouble has not yet become acute, the coping defects can be eliminated by replacing the coping course, and the course next below if necessary to secure greater depth, by a reinforced concrete cap which will distribute the superimposed load over a large area and, incidentally, reduce the effect of vibration on individual stones in the portion of the structure below the coping.

Safety in Handling Rail

What precautions should be observed when loading or unloading rails to prevent accidents to trains on adjacent tracks and avoid injury to the men?

Work Should Stop

By C. F. Larson
Superintendent of Safety, Missouri, Pacific, St. Louis, Mo.

In a previous discussion* concerning the safe handling of rails on push cars, emphasis was placed on the responsibility of the foreman for the safety of the employees engaged in this work. In other words, full responsibility for safety was placed on supervision in connection with work that carries an inherent hazard that can be eliminated or greatly reduced through proper organization and attentive supervision. In the present discussion we repeat that the foreman is the key man and that he must be alert and must assume full responsibility for every detail of the operation as well as for the completion of the whole job in a manner that will insure safety to both the men and trains.

When a train on an adjacent track approaches from either direction, the work must be stopped, no work in connection with the loading or unloading being done until the train has passed. On multiple-track, the rail should be placed on the outside of tracks when practicable. There must be complete understanding between the work-train conductor and the foreman as to train movements on adjacent tracks, so that the work of loading or unloading rails will be suspended while trains are passing.

Unless the foreman is given complete information he might have a rail suspended and swinging toward an adjacent track at the moment another train approaches. Being unable to swing it to clear, the rail will be struck by the train, and we can visualize the havoc to the men on and about the car and to the train, that is likely to follow. Assuming that the handling of the rail from or to cars creates an obstruction, it should never be done without first displaying stop signals in both directions for trains on adjacent tracks. When a track is to be obstructed or rendered unsafe in any way for the passage of trains, a competent maintenance of way flagman must be sent in each direction to afford the necessary protection. This is a general rule on all roads and is included in their maintenance of way rule books. In addition, train orders under which the work train is working protect the train and provide for avoiding delays to trains moving through its territory.

We must assume that any foreman who is competent to have charge of a gang engaged in loading or unloading rail under the conditions that are being discussed, has a thorough knowledge of all of the rules that apply to the protection of property and to the safety of his men, and that he has a hearty desire to comply with them. We also have the right to assume that the work-train conductor is likewise well informed about his duties and that both he and the foreman are in possession of the current timetables. With these protective measures and alert interest, there should be little danger that the work will not be performed safely, despite its hazard.

May I emphasize again that organization is important. One man should be designated to give commands and signals for all movements of the rail crane, such as securing hold, lifting, swinging, lowering and releasing the rail. He should always stand where he will be conspicuous, and all other workmen should know his position and be fully informed as to what is to be done, the words of command and the signals to be used.

A Work-Train Job

By J. B. Martin
General Inspector of Track, New York Central, Cleveland, Ohio

Loading and unloading rail are work-train jobs and the train crew should provide the necessary flag protection. One member of the train crew should also be on the lookout and warn the rail crew of trains approaching on adjacent tracks. There should be a clear understanding between the train and engine crews about the work to be performed, the speed of trains and with respect to signals. Again, practically all rail is now loaded and unloaded by means of power-operated cranes or derricks, and the operators of these machines should be experienced and competent men.

Every man in the rail crew should be assigned to a definite post with definite duties. One man in the car, ordinarily the man handling the rail tongs, should give the required signals until the rail is clear of the car. From this point the handling of the rail should be under control of a specially assigned man on the ground. In all cases there must be a clear and definite understanding as to whose duty it is to give signals to insure against confusion. Where practicable, regularly assigned rail-handling gangs should be assigned to this work, since this will promote safety and economy.

Inherently Hazardous

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

The loading and unloading of modern heavy-section rails are inherently hazardous, for which reason it is incumbent on both maintenance officers and foremen to throw all possible safeguards around these operations. As the first steps, the crane operator must be experienced and dependable; flagmen must be sent out in both directions to protect the train; and one of the train crew should be assigned to watch for and warn the operator

*Railway Engineering and Maintenance, January, 1940, page 32

of the approach of trains on adjacent tracks. Only one man should be designated to give signals at any time, and both the crane operator and the engine crew should be informed of this assignment.

Proper organization of the gang and a complete understanding of his duties by every man in the gang will go a long way to conserve safety. Watch should be kept to insure that when the rails are released by the crane they are fully supported throughout their length and are well in the clear. Most important, foremen and men alike should be drilled so thoroughly in safety that they will be constantly safety conscious.

Preventing Water Hammer

What effective means can be employed to prevent water hammer in pipe lines? What effect do elbows have? The diameter of the pipe?

Use Relief Valves

By E. M. Grime
Engineer of Water Service, Northern Pacific, St. Paul, Minn.

To discuss the prevention of water hammer, one should first know its cause. Present knowledge comes largely from the investigations conducted by M. Joukowsky in Moscow in 1897, and from Allievi's Theory of Water Hammer, published in Italy in 1903. Joukowsky developed an expression for the velocity of the surge wave which occurs when a column of water in motion is stopped abruptly, as by a check valve or a gate valve. Disregarding pipe friction, this surge wave travels in water at the same velocity as sound, or 4,700 ft. per sec. In other words, if the flow in a pipe 4,700 ft. long is stopped suddenly, the wave will travel to the source of supply and return in 2 sec. If the valve is closed completely before the surge wave returns, then maximum pressure will be developed.

If water were not compressible to a certain degree, and if the pipe material had no elasticity, water hammer would develop infinite pressure. Taking elasticity into account, however, it can be shown mathematically that the actual pressure developed is only 59.7 times the velocity of the column of water measured in feet per second. As an illustration, assume a 12-in. main serving a water column which delivers 3,000 g.p.m. The velocity of flow will be 8.4 ft. per sec., and if the water column has no relief valve but closes immediately, the pressure developed at the column would be 8.4 times 59.7 or 501 lb. per sq. in. If the pipe be increased to 14 in. and the delivery remains the same, the velocity will be 6.3 ft. per sec. and the pressure will be only 376 lb. per sq. in. In view of these facts, it is clear, if other conditions remain the same, that increasing the diameter of the pipe will decrease the magnitude of the water hammer. Since, for the usual operating requirement, the flow in the water column must be cut off almost instantly, the resulting surge is usually reduced by a relief valve or other slow-closing device.

So far as water hammer is concerned, elbows in a pipe line serve, in effect, merely to lengthen the pipe line to the extent of the pipe friction attributable to their presence, and thus increase the time required for the surge to return to the point of closure. The longer the pipe line the more time that must be allowed for valve closure to avoid excessive water hammer.

Where filters are used, as sometimes occurs on a treated-water line, care must be exercised to avoid water-hammer back pressure which may disrupt the filter bed. This may be avoided by installing a large sized air reservoir on the pumping line adjacent to the filters. On an 8-in. pipe line 2,000 ft. long, severe water-column hammer was minimized by making the closing time for the relief valve 13 sec. and by installing, in addition, a 10-in. air reservoir, 8 ft. long, on the line near the filters, to dampen any surge that might approach, in case any of the water-column adjustments got out of order.

Must Dissipate Energy

By C. R. Knowles
Superintendent Water Service, Illinois Central, Chicago

Water hammer or hydraulic shock caused by the sudden stopping of a column of water flowing through a pipe line is of great importance because of the possibility of damage inherent in it. Water in motion contains a certain amount of energy, depending on the volume of the water and the velocity of flow. If the flow is stopped suddenly, this energy must be dissipated in some way. Sudden stoppage, or a sudden reduction without complete stoppage, of the flow creates a shock pressure that is transmitted through the pipe with constant intensity, this pressure being proportional to the destroyed velocity of flow and to the speed of propagation of the pressure wave. In pipes having a diameter of 2 to 6 in., the increase of shock pressure is approximately 59 lb. for every foot per second of extinguished velocity of flow; for larger pipes it is somewhat less. To illustrate, the sudden closing of a valve in a line 2 to 6 in. in diameter, in which water is flowing at a velocity of 5 ft. per sec., will cause an increased pressure or water hammer of approximately 294 lb. per sq. in.

This shock pressure will be transmitted along the entire length of the pipe with constant intensity. A dangerous increase in this shock pressure occurs when the pressure wave passes from one pipe to a smaller one having a dead end. In this case, the shock pressure is doubled when the wave reaches the dead end. If there are several branches, one leading from another, this doubling may take place several times, with the result that the pressure may build itself up to great magnitude.

Probably the simplest method of preventing water hammer lies in the use of slow-closing valves. The duration of closure should be proportional to the length of the pipe line. Air chambers of adequate size, placed near valves and gates, and at other critical points in the line, will help to eliminate hydraulic shock and will not allow the pressure wave to pass through them, but to do this they must be of ample size. Relief valves probably offer the best solution where other means are not available or do not prove effective, as they will allow pressure waves to pass through them, of only such intensity as corresponds to the elasticity of the springs.

In railway water service, the principal trouble from water hammer occurs on lines to water columns, although the valves on water columns have been improved to such an extent that little trouble should be experienced if they are kept in adjustment. The probability of water hammer in a water-column line can be overcome by placing a relief valve of adequate size in the pipe line near the water column.

Of themselves, elbows or bends in pipe lines do not have any effect on

water hammer, other than to retard the progress of the shock-pressure wave. On the other hand, water hammer may have a decided effect on these fittings. For this reason, they should be blocked securely to prevent displacement by reason of water hammer or other excessive pressure.

Raise on Old or New Ballast?

When reballasting, should the track be raised on the old ballast, or should the old ballast be discarded to the bottom of the ties and only new ballast be used for making the raise? Why? Does the kind of ballast make any difference?

Depends on Old Ballast

By A. B. Chaney
District Engineer, Missouri Pacific, Little Rock, Ark.

If the old ballast is fouled to such an extent that it no longer affords drainage under the tie, or functions as ballast, it should be thrown out and used to strengthen the shoulder of the embankment, and the track should be raised on new ballast. Where the old ballast is good, it is economical to employ it for making the raise, and unload the new ballast for the purpose of restoring the ballast section.

Where more than one lift is to be made, the first one can be made on the old ballast, and the new ballast can be used for the others. In all cases, the most satisfactory results will be obtained by having clean ballast under the ties for adequate drainage. Trying to save old ballast without cleaning it will be found to be an expensive procedure in the long run, for dirt in the ballast, like infection in living tissues, tends to spread and spoil that which is good.

Crib Dirty Ballast

By L. B. Holt
Engineer of Track, New York Central, Cleveland, Ohio

Primarily, the purpose of reballasting is to correct surface irregularities and provide a uniform, resilient, free-draining support for the track. To accomplish this, clean ballast of all types, whether old or new, must be employed. When the same kind of ballast as is now in service is to be used for reballasting, best results are obtained by proceeding as follows:

First, determine whether the shoulders of the roadbed are of sufficient width and height properly to support the ballast slope after the raise is made. If the shoulders are adequate and the old ballast is clean, it will be satisfactory to raise on the old ballast, and follow the raise with a dressing of new ballast to restore the ballast section to standard. If the shoulders are too narrow or too low, or both, they should be widened or raised, using a free-draining material, such as cinders or gravel. After the banks have been restored, the raise can be made on the old ballast, if clean, and the track dressed to standard section with new ballast.

On the other hand, if the track has been ballasted with crushed stone or slag and the shoulders are of standard section, but the ballast is foul and obstructs drainage, the old ballast should be thrown out of the cribs onto the shoulders or into the inter-track space as the case may be. Ballast-cleaning machines should then be employed to remove the dirt, and this renovation, if done properly, will make the old ballast suitable for raising the track, using new ballast as before to restore the ballast section.

Where a different or better type of ballast is to be employed in making the raise, say stone or slag to replace cinders or gravel, the old ballast should first be removed to the bottom of the ties and used to strengthen the shoulders of the roadbed or discarded, as will best suit the case. This should then be followed by the application of new ballast.

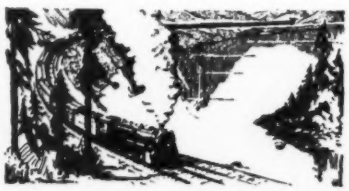
Painting Water Tanks

Should the hoops of wooden water tanks be loosened before painting the tub? Why?

Good Policy To Do So

By W. C. Harman
Supervisor of Bridges and Buildings, Southern Pacific, San Francisco, Cal.

My experience leads me to believe that it is better policy to loosen the hoops on water tanks before painting the tub. Any one who doubts the advisability of doing so should note the hoops on his next inspection and observe the abnormally thick section of some of the hoops. Investigation will show that this is being caused by the rust that is building up under them. If a sharp tool is proded into the wood under the hoops moisture will be discovered and, if the tank is an old one, decay will probably be in evidence. It must be obvious to anyone who has noted this situation over a period of years, that tank hoops should be loosened when painting the tub, if for no other reason than to clean and paint the hoops themselves. They should not only be loosened; they should be taken down, cleaned thoroughly and given a coat of good paint along with the painting of the wood under them.



Tank hoops rust more readily on the side next to the wood, for the reason that it is this side that seldom is painted, and consequently it is not protected against corrosion which results from the moisture between the hoop and the tank. It has also been my observation that tank staves decay most often on the outside of the tank and most frequently beneath and next to the hoops. This and corrosion of the hoops are less likely to occur where the hoops are removed, cleaned and painted each time the tub is painted.

The foregoing applies primarily to flat hoops, many of which are still in service. The round and half-round metal hoops hide less of the wood and, while it is advisable to loosen them, it is somewhat less necessary to do so. The painting of wooden tanks not only arrests decay, but the paint film prevents the entrance of termites, which have been known to bore entirely through the staves. It also aids greatly the proper tightening of the hoops and this, in turn, prevents loss of water. While the cost to loosen and clean the hoops is

considerably more expensive than just to let them go, it is money well spent when one considers the added life of the structure that can be obtained through careful maintenance.

Depends on Hoops

By G. S. Crites
Division Engineer, Baltimore & Ohio, Punxsutawney, Pa.

Whether the hoops on wooden water tanks should be loosened when the tub is painted depends in large measure on the hoops. If the half-round type is in use there is no benefit and there may be some harm in loosening them for painting. These hoops set themselves in the paint and in the fibre of the staves of the tub to such an extent that when loosened they leave places where moisture or fungi may get into the staves and start decay. Tubs with half-round hoops should be painted with the hoops in place.

This comment also applies to the full-round hoops, but in greater measure, since these hoops are sure to be bedded in the fibre of the staves and will hold water in the upper groove which they make with the staves. If such hoops are not disturbed when painting, this groove will catch and retain paint and in large measure will seal out moisture and germs that cause decay.

Flat hoops should be taken off, cleaned and painted on all surfaces. The staves should also be painted with no break in the paint film. The height of the water that is maintained in the tank while the painting is under way will determine whether one hoop or two may be removed at one time. Attempts have been made to use plastics or putties to waterproof the tops of hoops and thus avoid the removal of flat hoops, but the results obtained do not justify the procedure.

Yes, Both Flat and Round

By L. G. Byrd
Supervisor of Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

In general, when a water tank is up for painting, it will be found that the hoops have become severely corroded on the inner surface, that is, next to the tub. This applies to both flat and round hoops, and it is advisable to loosen the hoops, clean them thoroughly and give them a priming coat of red lead in oil or coat them with one of the rust inhibitors that have been found to be effective in protecting the hoops. Round hoops do not cover as large an area of the wood surface as the flat hoops and by applying a heavy dosage of the grease paint, as the rust-inhibiting compound is commonly known, on top of the hoop, the grease or vehicle for the inhibitor will work its way through the binding side of the hoop and afford protection against corrosion.

Otherwise, if the hoops are in good condititon, I see no real necessity for loosening the hoops when the tub is being painted. It is an advantage, however, for the protection of all hoops, to apply the grease paint or other suitable material to prevent water from getting between the hoops and staves.

When Selecting Work Equipment

What considerations should be given weight in the selection of work equipment?

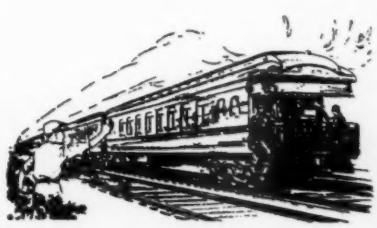
Must Be Real Need for It

By Armstrong Chinn
Chief Engineer, Alton, Chicago

In selecting work equipment, the first consideration is whether there is a real need for it. This need may arise from any one of several causes, such as the need for equipment to do work that cannot be done by hand; the need to do more work with the force that is available; the need to do better work; or the need to do work more economically. Having established a definite need, the next consideration should be dependability. To be worth while, work equipment must be in condition to work when and as needed. Nothing is so exasperating or more costly than to have a well-organized gang slowed down or stopped by the failure of a unit of work equipment.

Dependability is, therefore, the essence of satisfactory performance. The responsibility for dependability rests, first, with the manufacturer who must build his equipment so that it will not fail, and, second, with the maintenance officer to whom it is assigned, who must know that it is maintained and used as it should be. No matter how well a manufacturer may build his equipment, it cannot be expected to work without failure unless it is maintained and used properly.

These are the main considerations. A third is adaptability. The best return on the investment is secured from equipment that is used the most. Equipment that is adapted for several kinds of work will be likely to get the most use and will, therefore, pay the largest dividends. Adaptability can be considered from several viewpoints, particularly as it applies to two general types of equipment. The first of these is the type that does only one thing, but a thing that can be applied in several ways. An example is the air compressor. This equipment can be used to operate such widely divergent tools as tie tampers, rivet hammers, sand blasts, paint sprays, and numerous other tools for an equally wide range of work.



The second type can do several kinds of work. This is illustrated by the small crane that can lay rail, ditch, excavate, load and unload materials, and switch cars. The small railway that has only a limited amount of each kind of work and cannot hope, therefore, to keep a piece of equipment employed continuously on any one kind of work, will do well to consider the question of adaptability.

Must Determine Economy

By C. H. R. Howe
Cost Engineer, Chesapeake & Ohio, Richmond, Va.

It is necessary, first of all, to establish the fact that the return on the proposed investment will justify the purchase. To do this it must be shown that there will be a saving in labor or materials, or both, over and above the cost of methods or of equipment previously used. If past cost records are available for both old and new methods or machines, comparisons are simple: If such information is not obtainable, recourse must be made to time studies and these are not always infallible.

After economic justification for the purchase has been established, the next question is that of absorption. In other words, how many units of the particular equipment can the railway use to advantage, with the least loss

by reason of idle time. The productive capacity of the particular machine and the magnitude of the annual program should determine this point.

In recent years there has been discussion of the relative advantages of general-purpose and single-use machines; actually there is not much to argue about with respect to this matter. Many of the single-use machines are auxiliary tools for extending the utility of major pieces of equipment. For instance, such tools as pneumatic spike drivers, drills and wrenches; and others, such as electric drills, wrenches and grinders, may extend the use of air compressors and generators, thus reducing the idle time of these major units.

Self-contained power machines, such as bolt tighteners, rail drills or grinders may readily justify use if properly programmed for all-year work. Others of the single-purpose machines, tie adzers and spike pullers for instance, justify their use through the economies effected in extending rail life, reducing track surfacing or in spike salvage. When the desirability of purchase has been determined, the final step is, obviously, the selection of the equipment best adapted for the particular use to which it is to be put. Where a number of competitive machines are on the market, the question becomes not one of comparative first cost, but of comparative productivity per dollar invested. A number of factors that affect production costs must be considered. Simplicity of mechanical construction and design together with the quality of the materials employed, may reduce materially maintenance costs, as well as the loss of valuable time while the machines are being repaired.

Speed of operation is usually an important consideration, but not to the extent of incurring excessive charges for fuel and other supplies consumed, or undue costs for wear and tear. As a general proposition, equipment used for track or roadway maintenance should be considered with facility of handling in mind. That is, it should weigh no more than is consistent with the work that it is required to do.

How to Get Rid of Termites

When a building is found to be infested with termites, what methods can be employed to get rid of them? How effective are these methods?

Are Causing Damage

By L. G. Byrd
Supervisor of Bridge and Buildings, Missouri Pacific, Poplar Bluff, Mo.

In recent years we have discovered infestations of termites in quite a few of our buildings and many of them have sustained considerable damage before the discovery was made, through weakening of the structural members. Ordinarily the termites will spread from the foundation posts and sills to the joists, studding, columns, sheathing and siding.

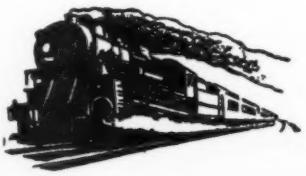
When general repairs are carried out in buildings that are infested with termites, it is our practice to remove all of the damaged members and any other timbers they have entered, even though damage is not yet apparent. Wherever practicable these members are replaced with creosoted material. Trenches are then constructed around foundation blocks, posts or walls and are filled with boiling creosote. Our experience is that this method is effective in eliminating the termites from the buildings. During a period of eight years we have treated many structures in this way and we have not observed a reappearance of the termites in any of them.

It is important to remove all defective parts and other parts into which the termites have entered, to eliminate any chance of further deterioration. The creosote in the trenches around piers and wall footings will tend to discourage them from constructing their passageways to these walls and from building their characteristic tunnels up the sides of the foundations.

Infestation Grows Serious

By General Inspector of Buildings

I consider this a timely question, for my observation leads me to believe that termites are infesting more buildings than is generally appreciated, and that the distribution of these pernicious insects in built-up communities is becoming more widespread. Where infestation has already occurred, the method to be employed will be determined by the type of construction. If the building rests on a masonry wall, and the infestation has only begun, the building can be raised enough to permit the installation of termite shields between the foundation and the sills. If the building rests on masonry piers the shields will be needed only over the piers.

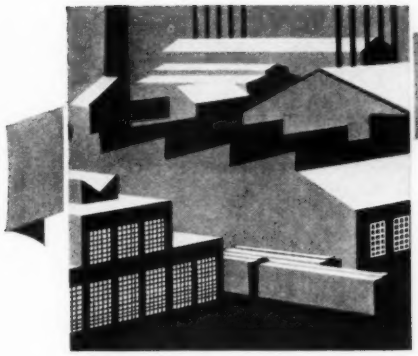


If the infestation has progressed to the point where the structural members have been weakened, the best thing is to remove these members and replace them with sound wood. In making the replacement, all members below the floor line should be creosoted. If the infestation has been severe or if termites are elsewhere in the neighborhood, all members, such as flooring, studding, siding, etc., above the floor line should be given one of the clean treatments, of which there are several on the market, which will allow the application of paint. As an added precaution, termite shields should also be installed.

Several facts should be kept in mind when giving consideration to this subject. The first is that the ground termites, which cause all but a small part of the damage in this country, cannot exist without an amount of moisture that is considerably greater than that contained in the members of an occupied building. For this reason, if the entrance channels into the building can be blocked, as with the shields, the insects already in the building will all die within a few hours, so that they will not cause any further damage.

The second is that the natural function of termites is to destroy dead wood and return it to the soil as rapidly as possible. In performing this function termites are assisted by certain decay-producing organisms that are always present where termites are at work. In other words, termites apparently carry the infection, and any wood in which termites have worked is likely to be infected and to rot much more rapidly than it would have done otherwise. It is a good idea, therefore, to remove all of those members of a building into which termites have made their entrance.

The third important fact is that termite colonies are maintained through the astounding reproductive ability of a queen, in much the same manner as a colony of honey bees. The queen resides in the ground and neither she nor her eggs ever get into a building. This is an important characteristic of these insects, for any termites that may be left in a structure when repairs are being made, will be unable to continue the colony.

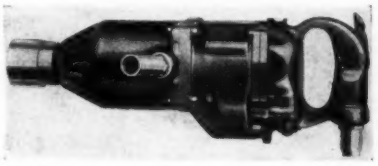


PRODUCTS of Manufacturers

Reversible Wrenches

THE Chicago Pneumatic Tool Company, New York, has developed two air-operated reversible wrenches, which are known as Models 365-R and 375-R. Because of their reversible feature these wrenches, which are of the "power vane" type, will rotate in either direction and hence the same wrench can be used for either applying or removing nuts.

The new wrenches are each powered with a slow-speed rotary motor and have springless driving units



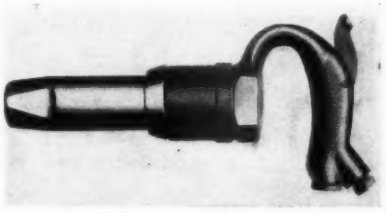
The New 365-R Reversible Wrench

without gears. The Model 375-R is the larger of the two, being 21¼ in. long and having a net weight of 61 lb., and may be used for handling nuts up to and including a bolt size of 1¾ in. Model 365-R is 16¼ in. long, has a net weight of 27½ lb. and has a capacity for handling nuts for bolts of as much as 1¼ in. in diameter.

Chipping and Calking Hammer

INGERSOLL-Rand Company, New York, has developed an air-operated, sleeve-valve, chipping and calking hammer, available in three sizes C1, C2 and C3, which was designed as a medium powered hammer for calking, such as seam and rivet calking, and chipping, such as plate trimming.

These hammers are compactly constructed with a conveniently shaped handle an integral part of the hammer. The throttle valve, which is controlled by a trigger extending conveniently from the upper portion of the handle, is of the Ingersoll-Rand combination piston and poppet type, which is said to be long wearing, leak-proof and to give a finely graduated control of



The Size C3 Ingersoll-Rand Chipping and Calking Hammer

the hammer blows. The C1, C2 and C3 weigh 10½, 10¾ and 11 lb. and have a piston stroke of 1 in., 1½ in. and 2 in., respectively. They vary in length from 11¼ to 12¼ in.

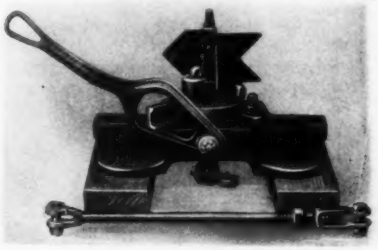
Improved Racor Switch Stands

THE Ramapo Ajax Division of the American Brake Shoe and Foundry Company, New York, has incorporated a number of improvements in its Style 20-B automatic safety switch stand and its Style 36-D parallel-throw gearless switch stand. These improvements are designed to add to the efficiency, economy and safety of the switch stands.

In the Style 20-B stand the improvements include the application of heavy forged turnbuckles on the moving rod to replace the former malleable iron units; the introduction of a lubricating fixture as a means of keeping the working parts properly oiled; and an improved method of bolting the interlocked target to the spindle, which is said to insure the proper alinement and to prevent the rattling of the target.

In addition, a plate extension on the horizontal lever covers the slots in the safety block and is said to prevent the accumulation of ice, snow or dust and to preclude interference with the padlock chain during the operation of the stand by hand. Moreover, to insure against the possibility of stands being thrown when locked, the shape of the slot in the handle has been so revised that the initial vertical component of thrust against the horizontal lever is almost 100 per cent. Finally, all parts of the stand now fit more closely than before, thus, it is said, deferring the accumulation of lost motion and thereby adding to the life of the stand.

Among the improvements that have been incorporated in the Style 36-D parallel-throw gearless switch stand is one that has been made for the purpose of removing any disadvantages that might be attributed to the fact that the toggle effect inherent in stands of this type produces a high leverage at the beginning and end of the throw and a lower leverage at the middle of the movement. This improvement consists of the introduction

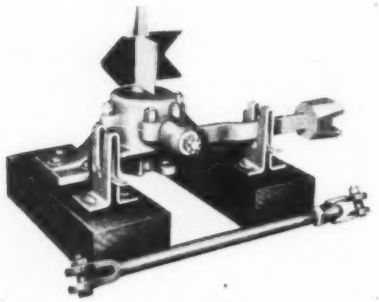


The Racor Style 20-B Automatic Safety Switch Stand

of lost motion between the handle and the operating shaft and a change in the angle of the operating crank with the result, it is said, that the leverage is increased at the center of the throw and decreased at the finish of the throw.

In addition, the diameter of the adjustable crank in the Style 36-D stand has been increased from 1½ in. to 1¾ in.; a special steel is employed in the manufacture of the crank to allow

smooth cutting of the threads; Whitworth threads with rounded grooves are used instead of V threads; the



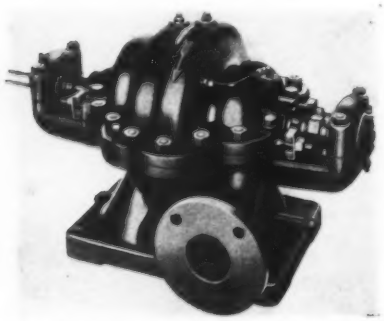
The Racor 36-D Parallel-Throw Gearless Switch Stand

crank eye and all working parts are heat-treated; the moving rod is fitted with a heavy forged turnbuckle, and the target is rigidly secured to the spindle. A special model, known as 36-H, is available, which is equipped with a rigid vertical extension to support a high spindle.

New Line of F-M Two-Stage Pumps

TO MEET the demand for better pumping equipment at head conditions above the range of single stage types, Fairbanks, Morse & Company, Chicago, has developed a line of two-stage, split-case pumps with capacities ranging up to 550 gal. per min. at heads ranging up to 600 ft., which are suited to all classes of pumping service where the liquid is of low viscosity and free from foreign matter.

The pumps are of the horizontal-centrifugal type with two impellers of cast iron, hard bronze, or other alloy as required, mounted back to back on



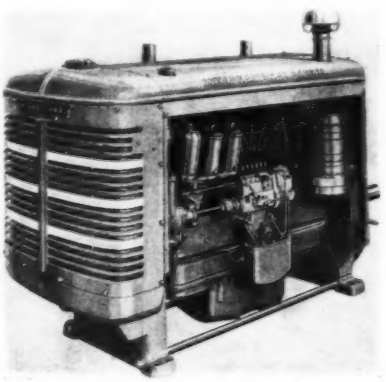
One of the New F-M, Two-Stage Split-Case Pumps

a high manganese alloy-steel shaft. The shaft is mounted in ball bearing journals and centrifugally-cast bronze shaft sleeves protect it against abrasive or corrosive action of the liquid. The stuffing boxes accommodate five rings of packing and a bronze water seal ring on the low pressure stage and a minimum of seven packing rings on the high pressure stage. The pump is housed in split casing, the lower section of which carries the suction and discharge openings, so that these connections need not be disturbed when the upper casing is removed for inspection of the pump interior.

The pumps are supplied as basic units or as base-mounted units direct-connected to electric motors or steam turbines. It is said that they are constructed of quality materials and their correct hydraulic design, with balanced "back-to-back" impellers, insures high operating efficiency and a long service life.

New International Power Units

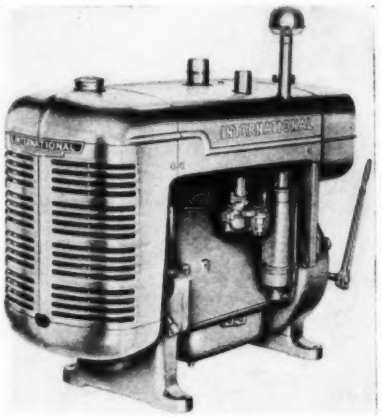
THE International Harvester Company, Chicago, is introducing two new power units; the model UD-18, a 6-cylinder, 100-hp. Diesel power unit, and the model U-2, a 4-cylinder, 22-



The Model UD-18, a Six-Cylinder 100-Hp. Diesel Unit

hp. valve-in-head engine for operation on gasoline, natural gas, distillate or kerosene. The U-2 is adapted particularly to many types of railroad service requiring power units of moderate size, such as coaling stations, drawbridges, smaller capacity air compressors, rail cranes, for charging batteries, and, to a limited extent in water stations and for the smaller power shovels and cranes. The UD-18 can be used as the power unit for large air compressors, for the larger shovels, draglines and cranes, and to a limited extent for driving generators.

The U-2 power unit is a compact four-cylinder, valve-in-head engine, with a three-inch bore and a four-inch stroke. It is equipped with an oil filter and a gear-type pump provides pressure lubrication. The main and connecting rod bearings are of the replaceable precision type, the crankshaft is electrically hardened by the Tocco method and the cylinders are replaceable. The governor, which is



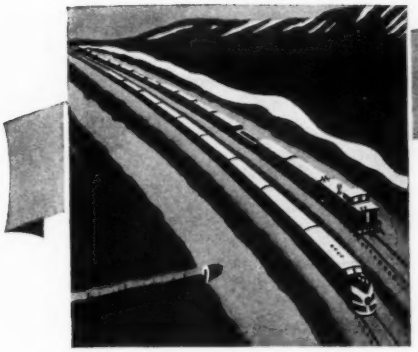
The New U-2, a Four-Cylinder, 22-Hp. Valve-in-Head Engine

a lever-adjusted, variable speed, fly-ball type, provides full control of the throttle at any engine speed from 1000 to 1800 r.p.m.

The U-2 weighs 665 lb., without fuel, oil and water, and develops 22 net horsepower when operating at 1800 r.p.m. It can be equipped to operate on gasoline, natural gas, distillate or kerosene. It is said that the design of the combustion chamber of the U-2 provides complete control of the rate of combustion, which prevents engine knocking and provides low fuel consumption, maximum power output and an increased engine life.

The UD-18 is a six-cylinder Diesel power unit, which starts on gasoline, and after a minute or less, shifts to full Diesel operation. It is provided with a heavy, large-diameter flywheel. It has a cylinder bore of 4¾ in. and a stroke of 6½ in., a seven-bearing Tocco-hardened, drop forged alloy-steel crank shaft, a radiator and thermostatically controlled cooling system, and full pressure lubrication. Its heat-treated cylinders are individually replaceable and all bearings are diamond-bored and are replaceable. A heavy-duty clutch is provided, which has 312 sq. in. of friction area and which locks in or out of engagement.

The UD-18 is compact, weighs 3,875 lb., and develops 100 hp. at 1,400 r.p.m. It can be provided with a battery and an electric starting system. It is said that it has ample weight and reserve strength for heavy duty service and that its smooth operation makes the construction of deep, expensive foundations unnecessary.



NEWS of the Month

20,253 New Freight Cars In Service in First Quarter

In the first three months of 1940, Class I railroads put in service 20,253 new freight cars, which was the largest number installed in any corresponding period since 1930, and was an increase of 15,149 compared with the number of freight cars put in service in the first quarter of 1939. On April 1, Class I railroads had on order 21,112 new freight cars, compared with 6,502 on the same day last year, and 5,825 on the same day in 1938.

British Rail Rates Increase 10 Per Cent

On May 1, the passenger fares and rail rates on the British railroads were increased 10 per cent to meet anticipated increases in operating expenses from rising wages and prices of materials. It is estimated that the increases will add about £18,000,000 (aproximately $90,000,000) to gross revenues for a 12-months period. The government guaranteed the roads net revenues of about £40,000,000 per annum under a war-time pooling scheme, when it assumed control of railroad operations, incident to the war.

Eastman Discusses Competitive Rate Theories

In a speech before the second annual transportation conference at Lincoln, Neb., on April 15, Joseph B. Eastman, chairman of the Interstate Commerce Commission, in discussing the "cost" and "share of traffic" rate theories said, "A dangerous condition exists if the railroads are ever to be restored to the degree of prosperity—which is necessary if they are to be able to attract investments of private capital, and if the other carriers, who have already had a plentitude of financial troubles, are not to be brought to the same pass. On the other hand, care must be exercised not to deprive the country of the benefit of new transportation facilities which are inherently more economical than older types.

"One proposal which has considerable support is that we should determine, with little attention to comparative costs, the relationship in rates which will enable competing types of carriers each to enjoy what is called a fair share of the traffic . . . Obviously, however, . . . there are many objections in the way of the widespread application of such a principle. At the other extreme, we are urged to determine the respective costs of transportation, establish a relationship accordingly, and let the chips fall where they may. Plainly far greater attention must be given to the costs of particular transportation services than has been customary in the past."

Eastman Subsidy Report

On April 15, Joseph B. Eastman made public a report, in four volumes, on Public Aids to Transportation. The study, which was begun when Mr. Eastman was federal co-ordinator of transportation, embodies cost-allocation formulae which purport to show the extent of government subsidation of the various forms of transportation. The report in general shows extensive government subsidies for air, steam railroad and water transportation, particularly the latter, and shows highway users "paying their way" by charging them with only 40 per cent, approximately, of the highway costs. Included in steam railroad subsidies are R.F.C. and P.W.A. loans. Credit for the report, according to Mr. Eastman, belongs to Dr. Charles S. Morgan, assistant director of the Bureau of Motor Carriers of the Interstate Commerce Commission.

Concerning the Eastman report, J. J. Pelley, president of the Association of American Railroads, said: "The report on highway costs just issued by the former federal co-ordinator of transportation boils down to this, that home owners, farmers and others who pay general taxes ought to pay 60 per cent of the total cost of highways and streets, while those who use the highways should pay only 40 per cent of the cost. It is only by making this astonishing assumption . . . that the authors of the report manage to arrive at the conclusion that motor vehicles are paying too much toward the cost of the highways built for and used by them."

Army Does Not Want to Run Railroads in Event of War

"Our railroads have proven their ability and their capacity. Those who operate them know more about transportation than any substitutes who could be mobilized in the midst of a grave crisis. The Army is not organized to run the railroads. It is honest enough to admit its own lack of training and capacity. It does not want the job. Moreover, it is satisfied that the railroads under private management are always in a state of national defense and are admirably suited to transport men and munitions in time of war.

Our confidence in the ability of the railroads to meet a transportation crisis more effectively than in 1917-18 is based, principally, upon the improvements which the industry, itself, has initiated. You have created and perfected an organization to meet the demands of war under private individual management. Our transportation plans are not rigid. They do not contemplate the regimenting of the railroads. Government operation of railroads is especially distasteful to us. We have predicated our whole industrial mobilization program on the maintenance of the established American way of getting things done.—From an address by Assistant Secretary of War Louis Johnson, on April 26, at the dedication of a bronze tablet in Washington, D.C., commemorating the services of the Railroad War Board in 1917.

Conferees Conclude Work On Transportation Bill

On April 19, the joint conference committee of the Senate and House of Representatives on S.2009, the omnibus transportation bill, reached an agreement on its final provisions and the bill will be considered by the Senate and the House at an early date. In general, although details of all its provisions have not been revealed, the bill provides for more or less co-ordinated regulation of rail, water and motor carriers. The bill offers the railroads relief from land grant rates, except for the transportation of military supplies and men, and provides for exceptions from the fourth section "long and short haul" clause. The bill includes a provision for a board to investigate the relative economy of the various agencies of transportation. The provisions of the bill concerning railroad consolidations and the Harrington amendment concerning "labor-protection" in the event of line consolidations, were stricken out by the joint conference committee.

Association News

Roadmasters Association

President G. L. Sitton has appointed Past President Elmer T. Howson, Vice-President A. B. Hillman and W. S. Lacher members of a committee to recommend a successor to C. A. Lichty, secretary, whose death is noted on a following page. A meeting of the Executive Committee will be held in Chicago on June 8.

Bridge and Building Association

A. E. Bechtelheimer, president, has appointed Past Presidents Elmer T. Howson, Armstrong Chinn and Fred E. Weise members of a committee to recommend a successor to C. A. Lichty, secretary-treasurer, whose death on April 18 is recorded elsewhere in this issue.

Track Supply Association

The Track Supply Association has sent a letter to members asking for reservations for space in its twenty-sixth annual exhibit which will be held at the Hotel Stevens, Chicago, on September 9-12, coincident with the convention of the Roadmasters and Maintenance of Way Association. Space will be allocated at a meeting of the Executive Committee on June 1.

Railway Tie Association

The Railway Tie Association will hold its twenty-second annual convention at the Brown Hotel, Louisville, Ky., on May 14-15. The program will be confined to the consideration of reports of committees on The Checking and Splitting of Ties; Standard Adzing and Boring; Timber Conservation; Changes in Dimensions of Crossties During the Seasoning Period; Manufacturing Practice; Moisture Gradient as a Determining Factor in the Treatment of Crossties; Specifications and Inspection; and Statistics. The annual dinner will be held on the evening of May 14.

Maintenance of Way Club of Chicago

One hundred five members and guests attended the annual meeting of the club at the Auditorium Hotel on April 22. At this meeting, which was preceded by a reception and dinner, A. A. Miller, chief engineer maintenance of way and structures, Missouri Pacific, discussed methods which have been employed on the Missouri Pacific to stabilize soft roadbed.

In the annual election of officers which followed the dinner, H. R. Clarke, engineer maintenance of way, Chicago, Burlington & Quincy, was advanced to president; Armstrong Chinn, chief engineer, Alton, was elected first vice-president; F. E. Schaumburg, roadmaster, Chicago & North Western, was elected second vice-president; and Neal D. Howard, managing editor, *Railway Engineering and Maintenance*, was re-elected secretary-treasurer. C. C. Pelley, track supervisor, Illinois Central; J. E. Wilkinson, roadmaster, Chicago & North Western; and N. A. Howell, sales engineer, Creepcheck Company, were elected directors for a term of two years. The membership at the end of the year was 246.

American Railway Engineering Association

Early in April, the association's booklet announcing the assignments and personnel of committees for the current year was mailed to all committee members. The secretary's office also sent to all association members letter ballots on certain amendments to the constitution, the most important of which provides for a junior grade of membership.

Four committees held meetings during April, as follows: Buildings, at Detroit, Mich., on April 18; Maintenance of Way Work Equipment, at Chicago, on April 23; Economics of Railway Labor, at Macon, Ga., on April 23; and Water Service, Fire Protection and Sanitation, at Kansas City, Mo., on April 25. Only two committees have thus far scheduled meetings during May, these being the Committee on Rail, which will meet at Chicago on May 7, and the Committee on Iron and Steel Structures, which will meet at Columbus, Ohio, on May 9 and 10.

Metropolitan Maintenance of Way Club

The annual meeting was held at the Governor Clinton hotel, New York, on April 25, with 50 members and guests in attendance. Following dinner a business meeting was held, which included the election of officers for the ensuing year. P. N. Wilson, superintendent of maintenance, Brooklyn-Manhattan Transit Lines, was advanced from first vice-president to president; J. M. Reardon, supervisor of track, New York, New Haven & Hartford, was elected first vice-president; M. S. Smith, Jr., supervisor of track, Pennsylvania, was elected second vice-president; and M. H. Dick, eastern editor, *Railway Engineering and Maintenance*, was elected secretary-treasurer. Members elected to the executive committee are T. Langan (retiring president), supervisor of track, Delaware, Lackawanna & Western; J. E. Egan, supervisor of track, New York Central; A. Drager, Central Railroad of New Jersey, and C. C. Connolly, American Fork and Hoe Company. The Outing committee reported that it had chosen June 20 as the date for the annual outing and that this function would again be held at the Houvenkopf Country Club.

Following the business meeting, the club was addressed by Earl H. Mills, general gas engine inspector, New York Central, and J. Holmes, supervisor of bridges and buildings, New York, New Haven & Hartford, who spoke on the History and Development of Work Equipment. Mr. Mills devoted his attention to track tools and equipment, while Mr. Holmes confined his remarks to equipment used by bridge and building men.

Personal Mention

General

H. H. Pevler, superintendent of the Logansport division of the Pennsylvania, has been promoted to superintendent of freight transportation of the Eastern region, with headquarters at Philadelphia, Pa., succeeding **R. W. Sheffer,** whose death on March 9 was announced in the April issue. **J. P. Newell, Jr.,** division engineer of the Long Island railroad, with headquarters at Jamaica, L. I., has been advanced to superintendent at Logansport Ind., replacing Mr. Pevler. A biographical sketch of the career of Mr. Pevler, accompanied by a photograph, was published in the May, 1939, issue of *Railway Engineering and Maintenance*, following his promotion to superintendent at Logansport.

Engineering

Willard J. Strout, principal assistant engineer of the Bangor & Aroostook, has been appointed acting chief engineer, with headquarters as before at Houlton, Me., to succeed **Parker C. Newbegin,** whose death was noted in the February issue.

L. R. Lamport, whose promotion on April 1, to division engineer of the Northern Iowa and Sioux City divisions of the Chicago & North Western, with headquarters at Sioux City, Iowa, was announced in the Aril issue, was born in Chicago on September 29, 1899, and graduated from the University of Illinois in 1923. He entered railway service between terms of school in June, 1920, as a rodman at Chadron, Neb., later serving during summer vacations and after graduation as tapeman, rodman, instrumentman and inspector. In March, 1925, he went with the Illinois Central, serving as a rodman on location and maintenance, and in September, 1927, he returned to the North Western as an engineering accountant at Chicago. Mr. Lamport was promoted to assistant engineer on the Galena division in November, 1928, and in September, 1937, he was appointed supervisor of work equipment, with headquarters as before at Chicago.

B. R. Kulp, whose promotion, effective April 1, to chief engineer of the Chicago & North Western, with headquarters at Chicago, was announced in the April issue, was born at Duncannon, Pa., on December 16, 1883, and graduated from Rensselaer Polytechnic Institute in 1905. Mr. Kulp obtained his first railroad experience as an instrumentman on the Galena division of the North Western. Later he was advanced to draftsman and to assistant engineer of maintenance on that division, and in 1909 he was transferred to terminal improvement work at Clinton, Iowa. During 1910 and 1911 he served as assistant engineer on yard improvements at Proviso, Ill., and in 1912 he was promoted to division engineer of the Ashland division at Antigo, Wis. Mr. Kulp was appointed

trainmaster on the Southern Illinois division at Benld, Ill., in 1917, where he remained until 1918, when he was transferred to the Galena division at Chicago. In 1920 he returned to the engineering department as division engineer of the Madison division, where he remained until May 1, 1931, when he was promoted to principal assistant engineer. Mr. Kulp was further advanced to engineer maintenance on January 1, 1936.

B. R. Kulp

E. C. Vandenburgh, whose promotion to engineer maintenance of the Chicago & North Western, with headquarters at Chicago, was announced in the April issue, was born in Audubon, Iowa, on March 26, 1887, and graduated from Iowa State College in 1908. He entered railway service on July 1, 1908, as a chainman in the engineering department of the North Western, later serving as a rodman, draftsman and instrumentman on location, construction and maintenance. On October 7, 1912, he was transferred to the signal department as an inspector and a year later he was advanced to chief draftsman in the same department. From July 11, 1914, to January 1, 1916, Mr. Vandenburgh served as assistant engineer on construction, returning to the signal department as assistant engineer on the latter date. Two years later he was appointed assistant general bridge inspector, which position he retained until April 7, 1924, when he was promoted to supervisor of bridges and buildings of the Madison division, with headquarters at Madison, Wis. On May 1, 1931, he was advanced to division engineer of the Northern Iowa and Sioux City divisions, with headquarters at Sioux City, Iowa, which position he held until his recent promotion.

E. C. Vandenburgh

Chester T. Dike, who relinquished his duties effective April 1, as chief engineer of the Chicago & North Western, but who continues as vice-president, with headquarters at Chicago, as announced in the April issue, was born at Woodstock, Ill., on August 13, 1871, and graduated from Cornell College in 1893. Subsequently he completed a post-graduate course in civil engineering. Mr. Dike entered railroad service in 1890 as a chainman on the Northern Pacific. His continuous railroad service began in 1896 when he became chief engineer of the Mason City & Clear Lake at Mason City, Iowa. In 1898 he was appointed chief engineer of the Iowa, Minnesota & North Western (now part of the C. & N. W.), and a year later he was appointed resident engineer of the North Western in charge of the location and construction of the I., M. & N. During 1901 and 1902 he served as resident engineer in charge of the location and construction of the Peoria & North Western and the Verdigre extension of the Chicago & North Western, while from 1903 to 1907 he was resident engineer and division engineer in charge of the location and construction of various branch lines of the latter road. He was then appointed superintendent of the Pierre, Rapid City & North Western (now part of the C. & N. W.), and from 1909 to 1911 he served as engineer and superintendent of construction of the Belle Fourche Valley, the James River Valley and other new line projects of the North Western. In the latter year he was promoted to general superintendent of the Minnesota and Dakota divisions, with headquarters at Huron, S. D., and during federal control of the railroads he was successively assistant general superintendent at Boone, Iowa, and assistant general manager at Omaha, Neb. Upon the termination of federal control in 1920, Mr. Dike was appointed engineer of maintenance, and on November 28, 1930, he was promoted to chief engineer. In the latter part of 1934, Mr. Dike was elected also vice-president of the North Western and of the Chicago, St. Paul, Minneapolis & Omaha.

Chester T. Dike

David A. Ruhl, general building inspector of the Chicago, Rock Island & Pacific, has been promoted to engineer of buildings, with headquarters as before at Chicago, succeeding **A. T. Hawk,** who has been appointed engineer architect, a newly created position. Mr. Ruhl was born at Des Moines, Iowa, on March 4, 1896, and was graduated from Cornell University, Ithaca, N. Y. He entered the service of the Rock Island on July 1, 1924, as a rodman in the engineering department at Des Moines, and on March 23, 1925, he was promoted to instrumentman at Chicago, several months later being promoted to senior instrumentman. On April 15, 1926, he was advanced to assistant engineer, and on January 1, 1929, he was appointed acting division engineer at Chicago. Mr. Ruhl was re-appointed assistant engineer on January 1, 1931; on March 1, 1932, he was appointed a track supervisor on the Illinois division, and on May 21, 1934, he returned to his former position as assistant engineer on the Chicago Terminal division. On October 1, 1935, he was appointed general foreman at the Chicago terminal and on August 21, 1937, he was promoted to stationmaster of the LaSalle Street station, Chicago. Mr. Ruhl was advanced to general building inspector, with headquarters at Chicago, in September, 1939, the position he held until his recent promotion, which was effective April 1, 1940.

David A. Ruhl

John W. Porter, whose promotion to principal assistant engineer and right of way agent of the Western region of the Canadian National, with headquarters at Winnipeg, Man., was announced in the April issue, was educated at Gordon's Technical College, Aberdeen, Scotland, and from 1896 to 1902, served his apprenticeship in the office of the chief engineer of the North of Scotland Railway (now the London & Northeastern). In 1902, he came to Canada and entered the service of the Canadian Pacific as a transitman, later becoming acting chief of party on location work. From 1904 to 1907, he served as a resident engineer on construction and on the latter date he was promoted to assistant engineer in charge of completing the construction of the Toron-

to-Sunbury line between Bolton, Ont., and Byng Inlet. In 1909, he went with the National Transcontinental Railway and in 1913, he was appointed chief engineer of the Hudson Bay Railway (now part of the Canadian National). In 1919, he was appointed special engineer on the Western

John W. Porter

region of the Canadian National and the following year he was appointed inspecting engineer assigned to the Grand Trunk arbitration reoprting on the condition of track, structures, etc., between Wolf Creek, Alta., and Prince Rupert, B. C., returning on the completion of this work to his position as special engineer. In the spring of 1929, Mr. Porter was promoted to principal assistant engineer of the Western region and in the fall of 1936, when this position was abolished, he was made office engineer, with headquarters as before at Winnipeg, the position he held until his recent promotion.

Roland H. Crew, division engineer on the Pennsylvania, who has been promoted to engineer maintenance of way of the

Roland H. Crew

Eastern Ohio division, as reported in the April issue, has been identified with this company for nearly 27 years. He was born on March 29, 1893, at Still Pond, Md., and was educated at Washington College and Swarthmore College, graduating in civil engineering from the latter institution in 1913. Mr. Crew also attended the Sorbonne at Paris in 1919, while attached to the American Expeditionary Force. He entered the service of the Pennsylvania on June 16, 1913, being connected with the engineer corps at Jersey City, N. J., until June 1, 1917, when he was appointed an assistant supervisor of track in the office of the chief engineer maintenance of way at Philadelphia, Pa. From November 21, 1917, to September 18, 1919, Mr. Crew was in military service with the A. E. F. At the end of this period he returned to the Pennsylvania as assistant supervisor of track, holding this position at various points. On April 6, 1926, he was promoted to supervisor of track on the Buffalo division at Warren, Pa., later being transferred to the Pittsburgh division at East Liberty, Pa. On August 1, 1929, he was advanced to assistant division engineer of the Philadelphia division at Harrisburg, Pa., being further promoted to division engineer of the Akron division at Akron, Ohio, on December 16 of the same year, later being assigned to special duty in the general office at Philadelphia with the same title. On June 1, 1932, he returned to the position of assistant division engineer, but was reappointed division engineer on July 1, 1933, holding this position at various points until February 1, 1938, when he was appointed acting engineer maintenance of way of the Eastern Pennsylvania division at Harrisburg. In July of the same year Mr. Crew was appointed division engineer of the Middle division at Altoona, Pa., where he was located at the time of his recent promotion to engineer maintenance of way at Pittsburgh.

P. M. Roeper, assistant division engineer on the Pennsylvania, with headquarters at Jersey City, N. J., has been promoted to division engineer, with headquarters at Erie, Pa., to succeed **P. W. Triplett,** who has been transferred to the Long Island (a subsidiary of the Pennsylvania), with headquarters at Jamaica, L. I., succeeding **J. P. Newell, Jr.,** whose appointment as superintendent at Logansport, Ind., is noted elsewhere in these columns. **M. C. Bitner,** supervisor of track at Baltimore, Md., has been promoted to assistant division engineer at Jersey City, to succeed Mr. Roeper.

Lawrence H. Jentoft, assistant division engineer on the Erie at Hornell, N. Y., whose promotion to division engineer, with headquarters at Dunmore, Pa., was announced in the March issue, was born on December 6, 1897, at Buffalo, N. Y. Mr. Jentoft attended Tri-State College, Angola, Ind., from which he was graduated in civil engineering in 1923. In September of the same year he entered the service of the Erie as a transitman on the Rochester division. In February, 1924, he was transferred to the Buffalo division and from June, 1929, to December, 1929, he served as office engineer on the Eastern district. He then became chief of corps on the Susquehanna division, and in March, 1932, he was transferred to the Buffalo division. In December, 1932, he became general foreman on the Mahoning division, with headquarters at Cleveland, Ohio, and from July, 1934, to February, 1936, Mr. Jentoft served as assistant division engineer on the Marion division, with headquarters at Huntington, Ind. He was then transferred to Hornell, N. Y., with jurisdiction over the Susquehanna, Delaware and Tioga divisions where he remained until his recent promotion to division engineer, which was effective on March 1.

Track

Leroy D. Shoda, track foreman on the Ft. Wayne division of the Pennsylvania, has been promoted to track supervisor on the Logansport division, with headquarters at Logansport, Ind., succeeding **Gus Evert.**

George S. Wooding, transitman on the engineering corps of the New York Central, has been promoted to assistant supervisor of track on Subdivision No. 25 of the Pennsylvania division, with headquarters at Wellsboro Junction, Pa., to succeed **B. W. Shaeffer,** who has been transferred to Elkhart, Ind.

Glenn William Davis, a section foreman on the Illinois Central, has been promoted to track supervisor at Reevesville, Ill., succeeding **Wayne Smith,** who has been transferred to Mattoon, Ill., replacing **T. J. Brosnahan.** Mr. Brosnahan has been transferred to Palestine, Ill., relieving **W. S. Williams,** who has been transferred to Bloomington, Ind., succeeding **Frank G. Murphy,** who has been retired from active service.

H. E. Wutzke, track supervisor on the Chicago, Rock Island & Pacific at Iowa Falls, Iowa, has been promoted to acting roadmaster, with headquarters at Sibley, Iowa, succeeding **Elbert H. Hays,** who has been transferred to Cedar Rapids, Iowa. Mr. Hays replaces **C. B. Murray,** who has been promoted to roadmaster at Amarillo, Tex., relieving **A. E. Causey,** whose promotion to master carpenter, with headquarters at Dalhart, Tex., is announced elsewhere in these columns.

G. A. Royce, assistant supervisor of track on the Eastern division of the Pennsylvania, with headquarters at Mansfield, Ohio, has been promoted to supervisor of track on the Monongahela division, with headquarters at Homestead, Pa., to succeed **G. C. Vaughn,** who has been transferred to the St. Louis division, with headquarters at Greenville, Ill. Mr. Vaughn replaces **J. W. Wallenius,** who has been transferred to Baltimore, Md., to succeed **M. C. Bitner,** whose promotion to assistant division engineer is noted elsewhere in these columns. **J. J. Maher,** assistant on the engineering corps of the Williamsport division, has been promoted to assistant supervisor of track on the Eastern division, at Mansfield, to replace Mr. Royce.

E. L. Hoffman, roadmaster on the Dakota division of the Chicago & North Western, with headquarters at Mankato, Minn., has been transferred to the Ashland division, at Antigo, Wis., to take the place of **J. Roszak,** who has been transferred to Ironwood, Mich., on the Ashland division, to succeed **A. L. Kickhafer,** retired. **F. C. Hajek,** roadmaster on the Northern Iowa division at Mason City, Ia., has been transferred to the Madison division, at Madison, Wis., to take the place of acting roadmaster **F. Wilcox,** who returns to his former position as sec-

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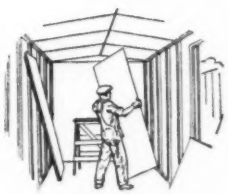

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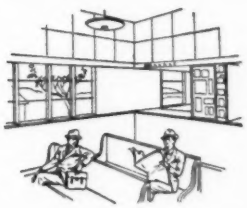

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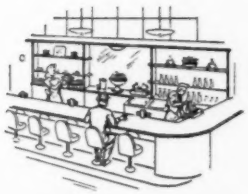

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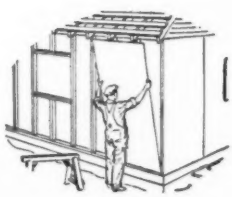

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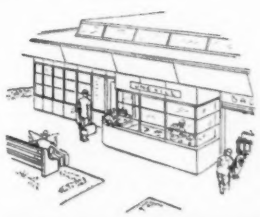

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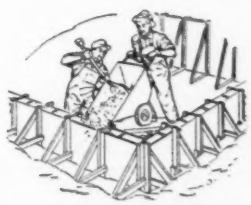

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tion foreman. **William Nieman,** roadmaster at Huron, S.D., has been transferred to Mankato, Minn., succeeding Mr. Hoffman. The positions of roadmaster formerly held by Mr. Hajek and Mr. Nieman at Mason City and Port Huron, respectively, have been abolished and these territories consolidated with other roadmaster's territories.

Lucien Desharnais, whose promotion to roadmaster on the Canadian Pacific with headquarters at Coronation, Alta., was announced in the March issue, was born at Chelmsford, Ont., on February 9, 1896, and entered railway service as a section laborer on the Canadian Pacific on July 11, 1911. He was promoted to section foreman on June 2, 1915, and transferred to Brooks, Alta., in 1920. In 1926, he was advanced to extra gang foreman and served in this capacity and as section foreman at Brooks until his recent promotion.

Algoth M. Olson, whose promotion to roadmaster on the Chicago, Milwaukee, St. Paul & Pacific at Mobridge, S. D., was announced in the March issue, was born at Horton, Mont., on September 11, 1912, and entered railway service on May 2, 1932, as a track laborer on the Milwaukee at Baker, Mont. In July, 1933, he was promoted to relief section foreman and served in that capacity on the Trans-Missouri division and as a machine operator on extra gang work on various divisions until 1935, when he was advanced to extra gang foreman. Mr. Olson served alternately as extra gang foreman and relief section foreman during the next few years until his promotion to roadmaster.

Special

Norman B. Gardner, a rail repairman in the maintenance of way department of the New York, New Haven & Hartford, has been promoted to supervisor of welding, effective April 1, to succeed **Joseph B. Whittemore,** whose death is noted elsewhere in these columns. Mr. Gardner was born in Canada on March 27, 1886, and entered the service of the New Haven in September, 1915, as a rodman on the Providence division. He was advanced to inspector in July, 1916, and thereafter served successively as fire claim agent and investigator. He became a rail repairman on September 1, 1937, which position he held until his recent promotion to supervisor of welding.

Murray C. Taylor, track supervisor on the Louisville & Nashville at Latonia, Ky., has been promoted to supervisor of work equipment, a newly created position, with headquarters at Louisville, Ky. Mr. Taylor was born at LaGrange, Ky., on November 8, 1896, and enlisted in the U. S. Army on April 7, 1917. He entered railway service in November, 1919, as a rodman on the L. C. & L. division of the L. & N., later working on location and construction. In June, 1921, he went with the engineering department of the City of Louisville, and in November, 1923, he became field engineer for the City of Paducah, Ky. Mr. Taylor returned to the L. & N. in March, 1924, as a rodman at Paris, Ky., and in June, 1928, he was promoted to track supervisor at Richmond, Ky., later serving at Butler, Ky., Winchester and Latonia.

Bridge and Building

A. E. Causey, roadmaster on the Chicago, Rock Island & Pacific, with headquarters at Amarillo, Tex., has been promoted to master carpenter, with headquarters at Dalhart, Tex., succeeding **F. J. Wirges,** who has been transferred to El Reno, Okla. Mr. Wirges relieves **L. F. Cooper,** who has been assigned to other duties.

Water Service

R. H. Beeder, whose promotion to general foreman of water service of the Western lines of the Atchison, Topeka & Santa Fe, with headquarters at Amarillo, Tex., was announced in the March issue, was born at Mobile, Ala., on August 26, 1905, and attended the University of Michigan. He entered railway service on September 1, 1925, as a draftsman in the office of the chief engineer of the Western lines of the Santa Fe at Amarillo and held various positions in the engineering department on the Western lines until November 1, 1935, when he was promoted to construction foreman on water service, heating and steel tank erection work. On October 1, 1939, he was advanced to general foreman of bridges and buildings on the Slaton division, with headquarters at Slaton, Tex., the position he held until his recent promotion.

Obituary

C. A. Lichty, a past president and for 31 years secretary-treasurer of the American Railway Bridge and Building Association, and also for four years secretary of the Roadmasters and Maintenance of Way Association, with headquarters at Chicago, died of a heart ailment at his home in that city on April 18 after a short illness. Mr. Lichty was born at Waterloo, Iowa, on May 24, 1865, and was graduated in civil engineering from the University of Iowa in 1890. He entered railway service that year with the Lake Erie & Western (now part of the Nickel Plate), serving as chief draftsman until July 1, 1892, when he went with the Chicago & North Western as acting division engineer of the Madison division. In 1896, he was appointed engineer in charge of the construction of double track on the same division, and two years later he was transferred to Iowa in charge of the construction of various lines in that state. In 1900, Mr. Lichty was appointed superintendent of bridges and buildings of the Iowa division, being transferred to the Northern Wisconsin division two years later. In 1906, he was appointed material inspector in the purchasing department, which position he held until his retirement on July 1, 1935. Mr. Lichty was president of the American Railway Bridge and Building Association in 1904-05, and in 1909 he was elected secretary of that organization, being elected also treasurer in 1915. He was elected assistant secretary of the Roadmasters and Maintenance of Way Association in 1935, and in 1937, he was elected secretary of that organization.

C. A. Lichty

Joseph B. Whittemore, supervisor of welding on the New York, New Haven & Hartford, with headquarters at Providence, R. I., died on March 6. Mr. Whittemore was born at Providence on March 17, 1878, and first entered the service of the New Haven in 1900 as an assistant engineer at Danbury, Conn. He resigned from this connection in 1900 but returned to the service of the New Haven on April 20, 1920, as a cost engineer. He then served successively as an assistant track supervisor, assistant engineer, transitman, chainman and signal foreman. On May 1, 1933, he was made supervisor of welding, which position he held until his death.

J. A. S. Redfield, who retired on August 31, 1937, as assistant engineer of maintenance of the Chicago & North Western, with headquarters at Chicago, died on April 4 at Ft. Lauderdale, Fla. He had been ill for some time. Mr. Redfield was born at Santa Barbara, Cal., on December 29, 1875, and graduated from Rensselaer Polytechnic Institute in 1898. He entered railway service on July 10, 1898, as a rodman on the Chicago & North Western, later serving as an instrumentman, assistant engineer and resident engineer on maintenance, location and construction. In 1908, he was promoted to division engineer and served in this capacity on various divisions until 1920, when he was further promoted to assistant engineer of maintenance, with headquarters at Omaha, Neb. Subsequently Mr. Redfield was transferred to Chicago, where he remained until his retirement on August 31, 1937.

J. George Bloom, who retired on February 1, 1929, as system engineer of maintenance of way of the Chicago, Rock Island & Pacific, with headquarters at Chicago, died suddenly of a heart attack at Pasadena, Cal., on March 30. Mr. Bloom was born at Xenia, Ohio, on November 25, 1869, and graduated in civil engineering from Ohio State University. He entered railway service in August, 1889, as a chainman on the Pennsylvania at Cincinnati, Ohio, then for the following 14 years acting successively as assistant engineer for the Kenova Land Associa-

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tion, assistant supervisor on the Norfolk & Western and assistant engineer at Cincinnati, division engineer at Flora, Ill., principal assistant engineer at Cincinnati and division engineer at Chllicothe, Ohio, on the Baltimore & Ohio Southwestern (now part of the Baltimore & Ohio) and division engineer on the B. & O. at Newcastle, Pa. From June, 1903, to December, 1909, he served the Rock Island as district engineer at Topeka, Kan., and as engineer of maintenance and district engineer of the Southwestern and Choctaw districts. He then left railway work to become president of the Southern Ballast Com-

J. George Bloom

pany at Denison, Tex., where he remained until July, 1912, when he was appointed superintendent of construction of the John F. Stevens Construction Company at New York. In October, 1914, he returned to the Rock Island to become connected with the valuation department at Chicago, being transferred to the operating department as superintendent of the Amarillo division, with headquarters at Amarillo, Tex., in July, 1916. Mr. Bloom was transferred to the Louisiana division, with headquarters at El Dorado, Ark., two years later and in May, 1921, he was appointed division engineer of the Nebraska-Colorado division at Fairbury, Neb. He was promoted to engineer of maintenance of way of the Rock Island in May, 1922.

Supply Trade News

General

Reed-Prentice of B. C. Ltd., Vancouver, B. C., a subsidiary of the Reed-Prentice Corporation, Worcester, Mass., has purchased the business and good will of the D. J. Smith Equipment Company, Ltd., Vancouver.

Personal

John A. Dillon, who resigned on January 1 as vice-president in charge of eastern sales at New York of the **Pittsburgh Screw & Bolt Corporation,** Pittsburgh, Pa., has formed the **Standard International Sales Corporation,** with offices in the New York Central building, New York. Mr. Dillon is president of the company and **Norman Allderdice** vice-president and secretary. The company will engage in export and domestic sales of steel and allied products, specializing in sales to railroads, car and locomotive builders, shipbuilders and oil companies.

Ward B. Maurer has been appointed district manager of the railway division, for lines west and south of Chicago, of the **American Hoist & Derrick Company,** St. Paul, Minn., with headquarters at Chicago.

George A. Blackmore, president of the **Union Switch & Signal Company** and of the **Westinghouse Air Brake Company,** has been elected chairman of the board of the **Duff-Norton Manufacturing Company,** Pittsburgh, Pa., succeeding **Thomas A. McGinley,** whose death is noted in this issue.

Yale D. Hills, supervisor of distributors of the **Timken Roller Bearing Company,** Canton, Ohio, has been appointed assistant general manager of the service-sales division. **J. F. Cornell,** manager of the Minneapolis, Minn., branch of this division, has been appointed special representative, with headquarters at Canton, and has been succeeded by **J. P. Roberts,** a salesman at Pittsburgh.

Earl E. Thulin, district manager of the **Duff-Norton Manufacturing Company,** Pittsburgh, Pa., with headquarters at Chicago, has been elected vice-president

Earl E. Thulin

and general manager of sales. For the present, he will be located at Chicago and later in the year will move to the general offices at Pittsburgh. **C. N. Thulin,** vice-president at Chicago, will act in a sales executive capacity as a special representative in all territories. **W. I. Floyd,** assistant to the president, at Pittsburgh, has also been appointed assistant general manager of sales, with the same headquarters.

Earl E. Thulin was born on May 8, 1901, in St. Paul, Minn., and after graduating from Lane Technical High School in Chicago, entered the employ of the sales and service department of the Duff-Norton Manufacturing Company. Later he became district manager at Chicago.

John J. Crowe, manager of the Apparatus Research and Development department of the **Air Reduction Company,** New York, has been appointed assistant to **Herman Van Fleet,** vice-president and operating manager. Mr. Crowe will direct the activities of the Apparatus Research & Development department and will co-ordinate these activities with similar activities for **Wilson Welder & Metals Co., Inc.** In addition, he will handle apparatus patent matters for Mr. Van Fleet. **H. E. Landis, Jr.,** assistant to Mr. Crowe, has been appointed manager of the Apparatus Research & Development department and **C. G. Andrew** has been appointed manager of gas plants.

Obituary

Thomas Atterbury McGinley, president of the **Duff-Norton Manufacturing Company,** Pittsburgh, Pa., died in that city after a short illness on April 13.

F. C. Snyder, manager of the railroad department of **Fairbanks, Morse & Company,** Chicago, died of a heart ailment on March 22. He was born on January 28, 1889, at Au Sable, Mich., and entered the employ of Fairbanks, Morse & Company as a stenographer in 1906. He served overseas during the World War.

Trade Publications

Concrete Vibrators—The Chicago Pneumatic Tool Company, New York, is distributing a 12-page illustrated booklet in which the various types of concrete vibrators manufactured by this company are described and illustrated.

Welding Chart—A guide for welding commonly used metals and alloys, form 4464, has been prepared in chart form by the Linde Air Products Company, New York, a unit of Union Carbide and Carbon Corporation. The chart presents in tabular form the recommended welding method, flame adjustment, welding rod and flux for welding each of 30 different metals and alloys.

Wood Preservation—A 24-page booklet with this title, featuring the various uses of wood treated with Wolman salts, has been published by the American Lumber & Treating Company, Chicago. The booklet contains descriptions and many illustrations of buildings, bridges and other railroad structures, in which "Wolmanized" lumber or timbers have been used. The booklet also contains a short chapter on specifications and a description of the treating and distribution facilities of this company.

Union Switch Stands—The Union Switch & Signal Co., Swissvale, Pa., has issued a 12-page, attractively-illustrated and printed booklet devoted to its T-20 and T-21 hand-operated switch stand. The several variations of each of these stands are described by means of text and photographs, while another section of the booklet, illustrated by drawings, depicts the various special features that are incorporated in both stands. The booklet also points out the various respects in which these switch stands conform to the standards of the American Railway Engineering Association.

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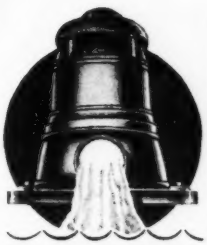

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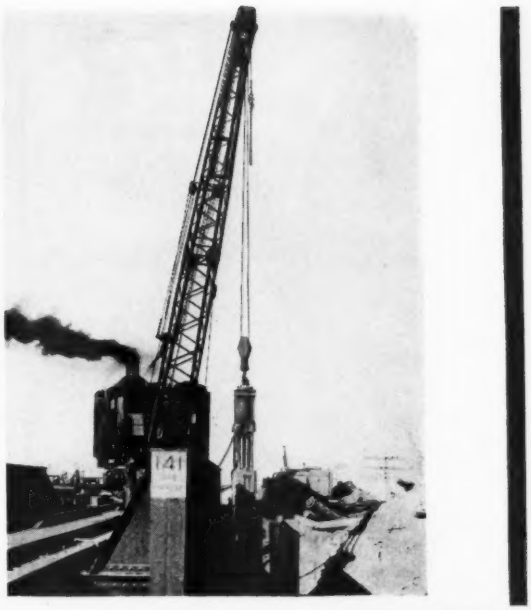

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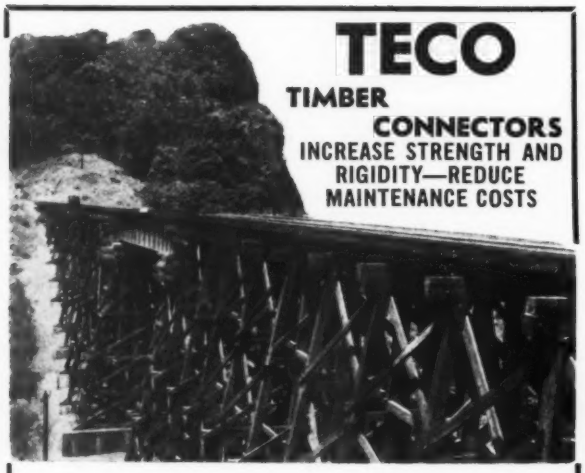

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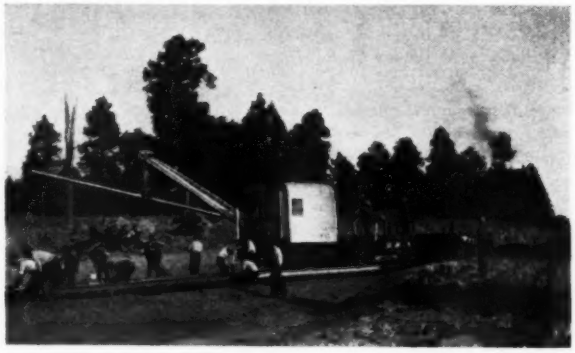

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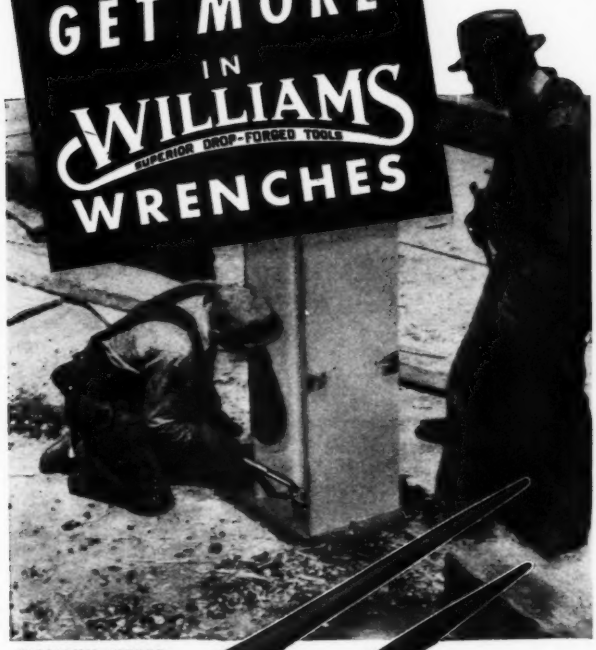

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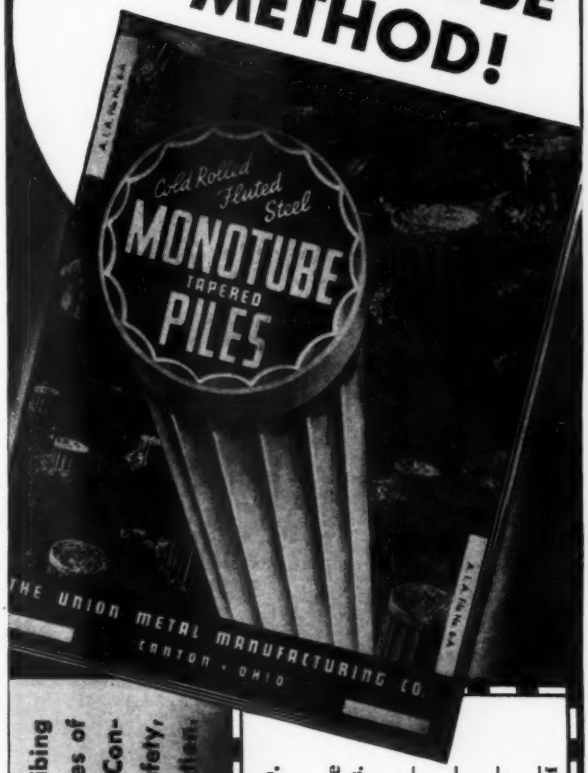

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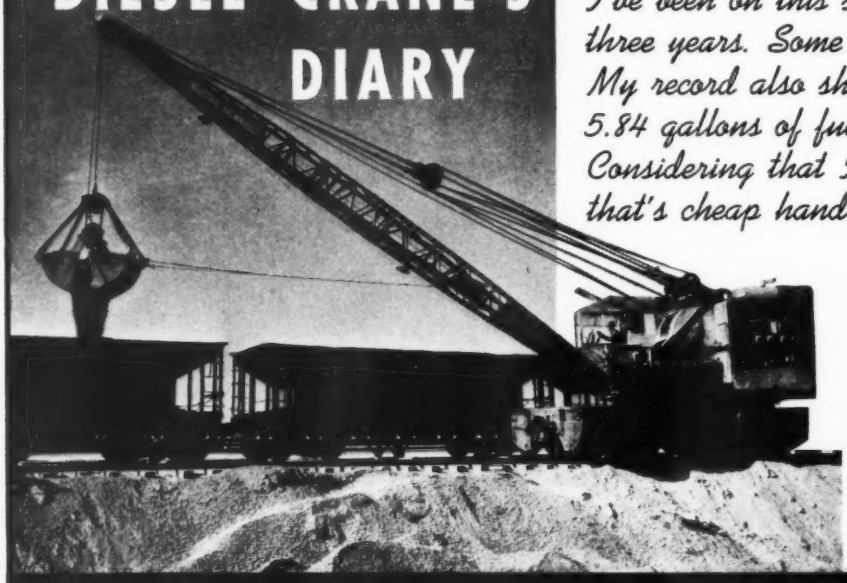

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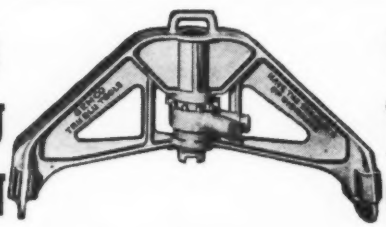

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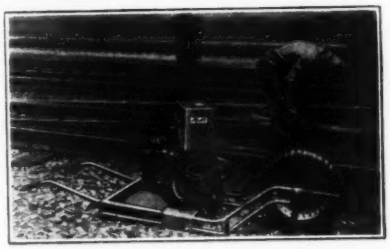

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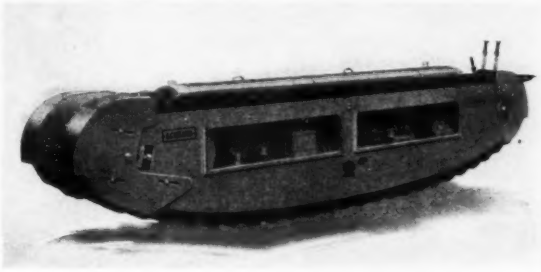

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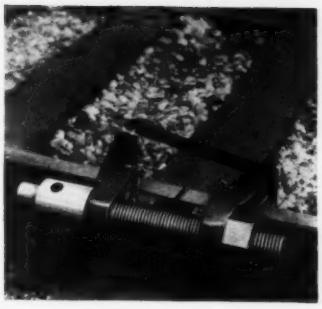

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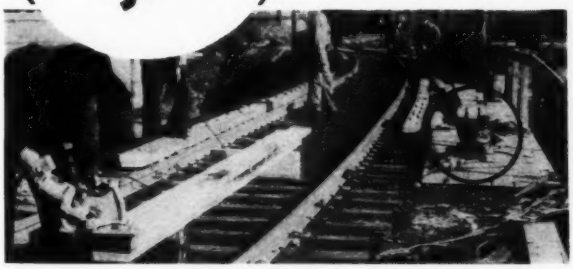

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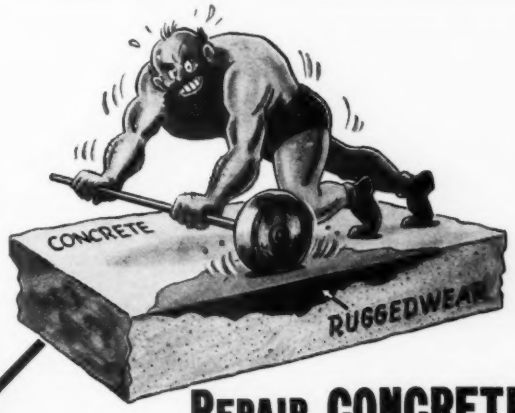

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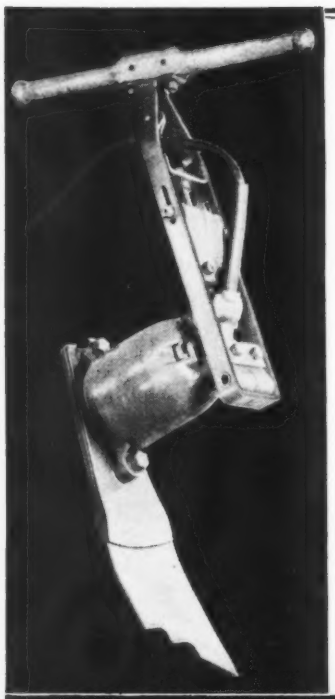

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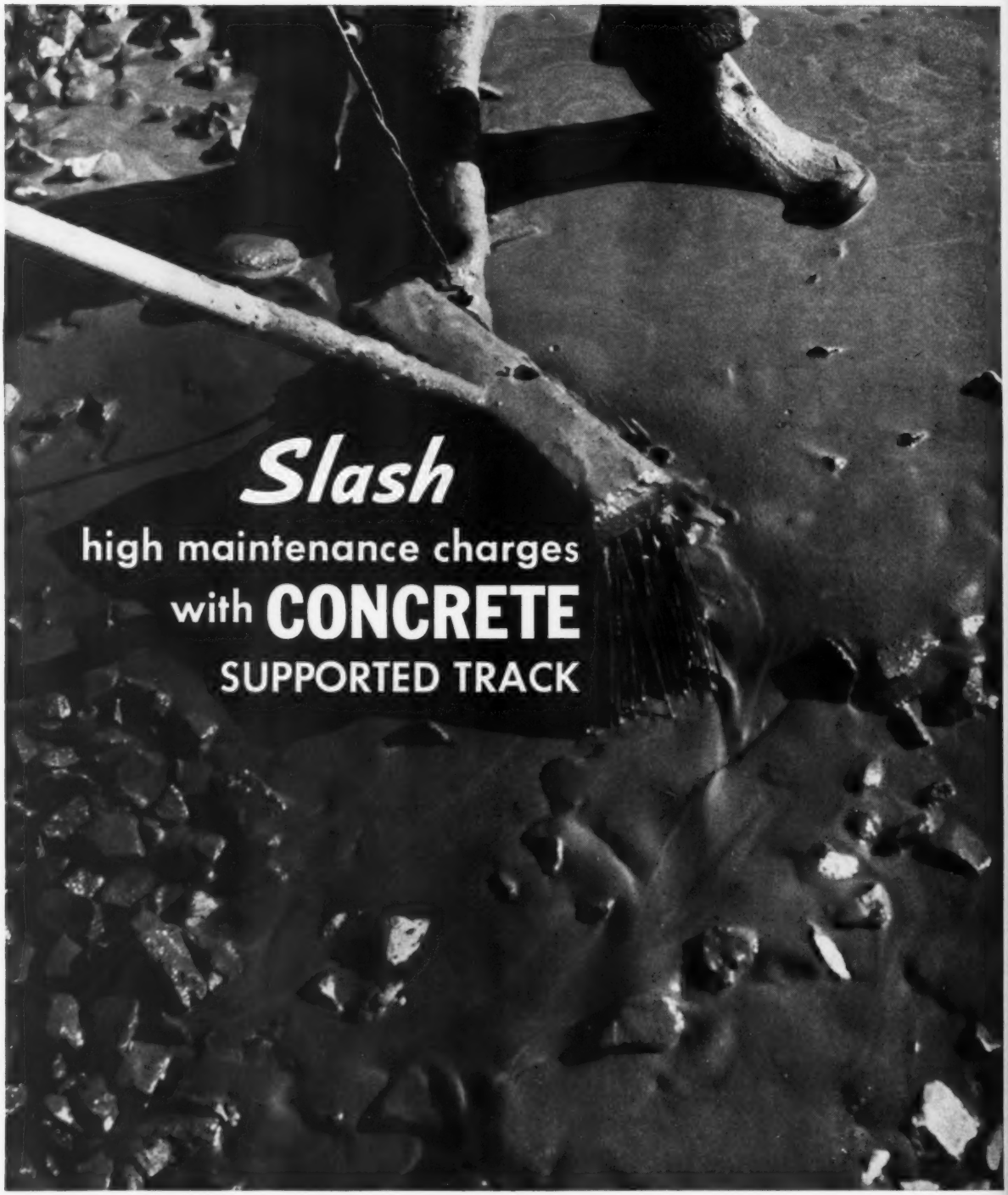

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